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THE DESIGN OF ALTERNATORS.

In another column Mr. R. P. Brousson writes on the determination of the E. M. F. of alternators, and in a manner which will place the subject within the reach of all. The design of alternators is a subject which has scarcely yet been touched upon in books, and, as remarked by the author, some of the considerations involved are surrounded by much haziness. The method adopted consists in basing the calculation of E. M. F. on the same simple formula used in continuous current design, with the introduction of a factor to account for the differences between the action of the two types of machines. This, of course, is the usual method, but the value of Mr. Brousson's article lies in the discussion of the constant referred to above. This constant has sometimes been given as a deduction from the form of the curve of E. M. F. generated, while, as explained, it depends solely upon the configuration of the magnet poles and armature coils, and can only be determined by a method taking these factors into consideration, or experimentally. The method proposed by the author is a very simple one, and has, besides, the advantage for students of enabling a clear understanding to be had of the generation of an alternating E. M. F. in a commercial machine. The entire absence of mathematics beyond an arithmetical formula will be welcomed, and those who have wondered at the stress often laid by writers on alternating design on the factor of self-inductance will not regret its non-appearance.

WHAT MIGHT HAVE BEEN.

In the current issue of the *Proceedings* of the Physical Society is an interesting note by Prof. S. P. Thompson, on an experiment of Ampère which barely failed of anticipating the great discovery by Faraday, ten years later, of magnetic induction. The apparatus used consisted of a movable coil suspended concentrically inside another coil carrying a current. In a first experiment, made in 1821, no effect was noticed upon the approach of a magnet toward the apparatus, but a year later in similar experiments with another apparatus but the same in principle, motion of the inner circuit was observed. Unfortunately for the experimenter, instead of following the Faradic method and developing the phenomenon to its full consequence, it was thought sufficient to lay down the principle that the experiment showed non-magnetic bodies to be susceptible to a sort of momentary magnetization. The same note refers to an even earlier experiment (1820) made by Fresnel with a view to determining the effect of a magnet in producing a current, but in this case also a neglect to persistently interrogate Nature led to a similar abortive result. Thus two of the greatest minds of the century had dwelt, years before the discovery of Faraday, upon the possibility of the production of electric currents by induction and, though on the verge of establishing the principle, they failed through a lack of the quality of humble and patient experimental perseverance, which transcends all others when attempting to arrive at the secrets of Nature.

COST OF PRODUCING ELECTRICAL ENERGY.

In our issue of July 20 a table was printed showing the cost of generating electrical energy in the various central stations in London, and in the Digest of the present number will be found data relating to provincial English stations. In London the cost per kilowatt-hour is almost eight cents, and we now learn that in the provinces this amount is exceeded in the stations owned and operated by private companies (nine cents), and is less in municipal stations (seven cents). In the latter case, however, it seems that the equivocal system of figuring costs by municipal authorities so prevalent in

this country is not unknown in England. It would be interesting to know how greatly the above costs are affected by the load factor, and how cheaply electrical energy could be produced per unit in the same stations under the most favorable conditions possible. We recently printed some data published by Mr. G. J. Melms, of the Frankfort, Germany, central station, which are of interest in this connection. At present the Frankfort station charges 16 cents per kilowatt-hour for lighting service and four cents per kilowatt-hour for motor service in the daytime. Mr. Melms states, however, that in large quantities his station could sell electrical energy with profit for 1.3 cents per kilowatt-hour on the condition that it be taken for 24 hours daily during nine months in the year, and for 20 hours daily during the three winter months of the year. The discrepancy between present charges and that which might be made under ideal conditions is here very great, and a comparison on the same basis with one of the large English or American stations would be of great interest. While the English data published might be used for this purpose, the result would be open to much more doubt than if it were determined by one of the station managers, who would not be entirely dependent upon assumptions with respect to the value of various factors would assume on the basis of comparison adopted.

THE FORM OF CURVES OF ALTERNATING E. M. F.

In the Digest will be found two abstracts of recent German researches on the relative efficiency of different forms of curves of alternating E. M. F., which, while not taking into account all of the factors concerned, are yet of much interest. Both refer to the effect on transformers of curves of different form, and both found that a pointed primary curve of E. M. F. is the most economical in this connection. This was to be expected, as Steinmetz has shown that the hysteretic loss, depending as it does upon only the extreme values of the induction and not upon its rate of variation, must be less with the flat-topped curve of magnetization which results from a peaked curve of E. M. F. While this is important on ordinary lighting circuits, it is not the only factor which intervenes, and does not, of course, apply to transmission circuits. Counterbalancing effects on lighting circuits are the greater drop with peaked curves, affecting regulation, and the poorer working of arc lamps. On long-distance circuits, the increase of inductive drop becomes of much importance and, with high voltages, the increased insulation strain with peaked curves is another disadvantage. The German experimenters do not take up the case of motors, in which connection the question has, perhaps, its greatest importance. Several experimenters have found that with other than sine curves motors work badly, and we know of no case in which the reverse has been demonstrated. Assuming, however, that a motor, notwithstanding the form of its curve, will work well if supplied by an E. M. F. having the same form of curve, the necessity of a standard form of curve is implied and, for motor work, at least, there can be no question, with our present knowledge, but that the sine form is the best. The question is one which our colleges might well take up as a subject for laboratory determination, and we hope before long that some American data will thus be contributed to the discussion. Owing, however, to the number of factors intervening, it is necessary that great care be taken in experimenting in order that the various effects may be differentiated. Thus far it is not clear that this has been done.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The coming meeting at Springfield of the American Association for the Advancement of Science is heralded as one containing much promise, which prediction all will be glad to see verified. Thus far the American Association has scarcely come up to the standard set by its British prototype, whose meetings are regarded the world over as one of the most important scientific events of the year. It is, however, only with respect to the British body that this is true, for in other countries the associations modelled after the former do not seem to meet with any degree of success whatever. The success of the British Association has doubtless been largely due to the fact that its annual meetings have frequently been the occasion selected by great lights in the scientific world for the promulgation of new doctrines. Another factor tending very greatly to its prestige has been the work of committees appointed from its membership, such, for example, as that which founded our present system of absolute electrical units. We are also inclined to believe that more care is bestowed by our cousins in the selection of papers offered for reading, in which respect our body is particularly lax. We have the authority of Mr. Edward Weston that in England the reading of papers is not far removed from a mania. In England, however, this peculiar form of mania seems to be confined to the authors of papers, while here it is rather the affliction of those whose duty consists in getting up the programme of papers for reading before scientific bodies. The latter too often apply the old maid's criterion and willingly accept a paper merely because it is a paper, or solicit papers regardless of the fact that those requested to contribute have little or nothing original to offer. The American Institute of Electrical Engineers formerly suffered much from these mistaken views, and the American Association has been reproached for the manner in which its proceedings are thus diluted. A more strict criterion applied to its papers, a greater effort to have the inaugural address a deliverance of real weight, and the institution of important committee work, would give the body the standing which it should have in order to satisfactorily fulfill its ends as a national body of science.

Graduation in Business.

Socrates taught that the essence of knowledge is definition; and it has been said by more than one wise man in later times that the beginning of science, which is correlated knowledge, consists in measurement. Be all this as it may, it is certain that one of the earliest attempts of science or knowledge was to put a measure upon itself, to define the degree of success with which a votary may have mastered it. Indeed, long before science could claim to be "exact," in the modern meaning of the term, its students sought to proclaim their status by a series of carefully and exactly defined labels, commonly called degrees. In earliest times these degrees were few in kind, and they served rather to indicate the extent of a student's mental expansion than to represent his qualification for special practice. Nowadays, however, degrees are not only more numerous in kind, but serve as the ostensible guarantee of a man's proficiency in some one or other line of business.

This important distinction between two classes of degrees, entirely opposite in their intention, is not always as carefully attended to as might be by authorities in educational matters. There is noticeable sometimes a tendency to give to the modern business degree that same wide latitude which is reasonable enough in degrees of a more purely ornamental character. When a man wishes to widen and deepen his general education by a course of study in the arts, it matters little or nothing whether his mind is expanded by this or by that form of intellectual labor. To-day he may choose Latin and Greek; had he lived in ancient Athens he might with equal mental advantage have chosen Egyptian and Chaldean. But when it is the purpose of the man to practice the business of, say, administering drugs to his fellow man, the sublimest knowledge of the classics cannot compensate for ignorance of the effects of one single drug; or, if he intends to practise as a mining engineer, the utmost proficiency in chemical analysis cannot avail in place of a thorough knowledge of the practice of mining.—*London Electrician.*

The Niagara Plant.

On Monday morning the Niagara Falls Power Company first began to generate current for commercial service. The first current was delivered to the works of the Pittsburg Reduction Company from dynamo No. 2 in the power house, about 2,000 hp being used.

The Society for the Promotion of Engineering Education.

The Society for the Promotion of Engineering Education will hold its second annual meeting, in connection with the American Association for the Advancement of Science, beginning Sept. 2, and closing Sept. 4, the sessions being held in the chapel of the South Congregational Church, corner of Maple and High streets. The following is the programme:

1. "A Quarter Century of Progress in Engineering Instruction," Robert Fletcher, Thayer School C. E., Hanover, N. H.

2. "Entrance Requirements." Report of committee, with discussion, F. O. Marvin, Kansas City University, Lawrence, Kas., Chairman.

3. "The Scope of an Engineering School, with Especial Reference to its Assuming Duties now Left to the Preparatory Schools, and Extending its Course on the Other Hand to Include Postgraduate work," Wm. G. Raymond, Rens. Polytechnic Institute, Troy, N. Y.

4. "The Present Requirements of American Engineering Schools in Non-Professional Studies," Louis E. Reber, Pennsylvania State College, State College, Pa.

5. "Culture Studies in Engineering Schools—Languages, History, Political Science," E. A. Fuertes, Cornell University, Ithaca, N. Y.

6. "Mathematics. What Should Be Taught in the Undergraduate Course, and What Left to the Postgraduate Period," C. F. Brackett, Princeton, N. J.

7. "A Course of Study in the Physical Sciences," C. T. Mees, Rose Polytechnic Institute, Terre Haute, Ind.; C. B. Dudley, chemist Pennsylvania Railway, Altoona, Pa.; R. S. Woodward, Columbia College, New York; G. C. Comstock, University of Wisconsin, Madison, Wis.

8. "Professional Studies"—Subjects to be treated and time to be given to each.

(a) "Civil Engineering, if one Course," C. L. Crandall, Cornell University, Ithaca, N. Y.

(b) "Civil Engineering in Specialized Courses," Chas. C. Brown, city engineer, Indianapolis; Mansfield Merriman, Lehigh University, Bethlehem, Pa.

(c) "Mechanical Engineering," H. W. Spangler, University of Pennsylvania, Philadelphia, Pa.

(d) "Electrical Engineering," D. C. Jackson, University of Wisconsin, Madison, Wis.

(e) "Teaching Industrial Applications of Electricity," Geo. D. Shepardson, University of Minnesota, Minneapolis, Minn.

(f) "Mining Engineering," Regis Chauvenet, Golden, Col.

(g) "Mining Engineering Laboratories," H. O. Hofman, Massachusetts Institute Technical, Boston, Mass.

9. "A Course of Instruction in Engineering Materials," J. B. Johnson, Washington University, St. Louis, Mo.

10. "Graphical Methods in General. How Far Taught?" L. M. Hoskins, Stanford University, Palo Alto, Cal.

11. "Text Books, Specifications for," I. O. Baker, University of Illinois, Champaign, Ill.

12. "The True Place of Drawing and Shop-work in Engineering Schools," C. H. Benjamin, Case School Applied Science, Cleveland, O.

13. "Graduation, Theses and Degrees," Storm Bull, University of Wisconsin, Madison, Wis.

14. "Modified Requirements for Graduation of Students Who Have Taken Full Literary College Courses," Ira W. Hollis, Harvard University, Cambridge, Mass.

15. "Comparative Value of Graduate Study in Engineering Courses," Wm. H. Burr, Columbia College, New York City, N. Y.

16. "The Economic Element in Technical Education," L. S. Randolph, Blacksburg, Va.

17. "Some Foreign Criticisms of American Engineering Schools," by C. Wilhelm Ritter, Zurich, Switzerland; H. L. Hele-Shaw, Liverpool, England; Ernst Voit, Munich, Germany; John Goodman, Leeds, England; Wm. C. Unwin, London, England; Dr. Hans Bunte, Karlsruhe, Germany.

Institute Papers.

In giving a brief summary of the proceedings of the Niagara Falls meeting of the American Institute of Electrical Engineers, the London *Electrical Review* adds the following remark: "We hope electrical men in this country will give us some good and practical papers at the British Association meeting in September. Such a meeting as that held at Niagara, of the American Institute, shows how much we are behind our United States confrères in this direction."

Another Niagara Electrical Plant.

Work has been begun at Niagara on the site of a power house to be erected immediately below the upper suspension bridge. The building will be constructed from stone quarried in making the excavations, and will be two stories in height, 100 feet wide and 50 feet long. This will allow it to be extended in length at any time.

The old overflow from the canal basin is being walled up and will be used as the flume to feed the basin that will furnish water for the penstocks. The gates will be moved from their present location to within a few feet of the top of the high bank. At right angles with the flume extending south toward the Cliff Paper Company's mill, an auxiliary canal is to be dug. It will be 30 feet wide and 22 feet deep. From this canal the penstocks will lead directly over the bank to the power house below.

The loose earth on the top of the bank is now being cleared away to secure a foundation for the penstocks and canal walls. The flume and canal are being constructed to furnish water for about 15,000 hp, but the buildings, etc., will be erected for a capacity of 30,000 hp. When more power is needed another flume will be built from the south end of the present canal basin.

The excavation on the bank for the power house is being made by hydraulic means; the slope is being washed away by a four-inch stream of water taken from the bank above, which does the work of 100 men. The company's engineer, Mr. W. C. Johnson, estimates that when the power house is completed it will furnish 10,000 hp, which can easily be increased as required.

American Association for the Advancement of Science.

BY WILLIAM HENRY HALE.

A brief sketch of this association was published in THE ELECTRICAL WORLD, of Aug. 18, 1894, page 147. The Brooklyn meeting, then in progress, proved to be, as the writer was confident it would when he presented the motion at Madison in 1893, to hold the ensuing meeting at Brooklyn, an important and interesting one.

Partial reports of this meeting were given in the issues of Aug. 25, and Sept. 1. The annual volume of proceedings issued by the association a few months ago gives additional information as to its present condition. The annual addresses of the retiring president and of the several vice-presidents are given in full, as well as abstracts of the papers read before the several sections. Owing to the unprecedented number of members dropped for non-payment of dues, the statistics of membership show a slight falling off compared with recent years, notwithstanding the large accession at the Brooklyn meeting. The geographical distribution of members shows the truly national character of the association, nearly or quite every State being represented, besides foreign countries.

The large corps of scientific experts in government employ are a conspicuous element, 109 fellows and 65 members being enrolled from Washington; a list surpassed only by New York City, which has 57 fellows and 127 members, but 9 of those credited to New York actually reside in Brooklyn, showing the aggregate New York membership 175 and Washington 174; of those now surviving Brooklyn comes next, with a total membership of 86; while Philadelphia and Boston have between 40 and 50 each.

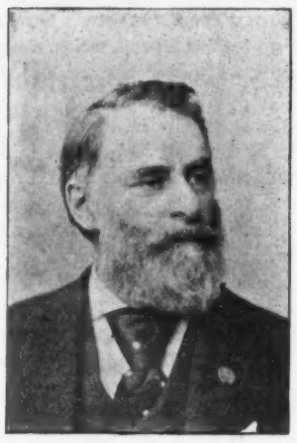
Of the venerable men who founded the association in 1848, a few still survive, and by vote of the council last year were made honorary life members. Of this little band death has already removed Dr. John H. Redfield, of Philadelphia, and Prof. James D. Dana, of Yale, leaving, as shown by the catalogue, Thomas T. Bouvé, of Boston; Epes S. Dixwell, of Cambridge; Traill Green, of Easton; James Hall, of Albany; Bela Hubbard, of Detroit, and Charles E. West, of Brooklyn. To these are to be added Prof. J. D. Whitney, of California, and Oliver P. Hubbard, of Dartmouth, of whom Secretary Putnam did not know in time to add to the list.

Of those who were original fellows at the time the association was incorporated in 1874, the list now gives names of 87 survivors, of whom Washington claims the largest number, 15. Next comes Brooklyn and New Haven with 5 each. Brooklyn had until recently 7, but Darwin G. Eaton and P. H. Van der Weyde have died during the year, almost at the same time.

In bringing the association to Brooklyn the writer promised a large accession of members, and is gratified to note that the Brooklyn membership is three times as numerous as before the Brooklyn meeting.

We adjourned last Summer in the full expectation of meeting this year at San Francisco, as Prof. Joseph Le Conte has for three years been bringing the most cordial invitations from the Pacific slope.

The committee in charge, however, could secure no adequate rates of transportation, and the council in January decided to meet at Springfield, Mass. This will be a return to New England after an absence of 15 years since the memorable meeting at Boston. Never before has half so long an interval elapsed without a touch of the inspiring soil of New England. Much is expected of our Springfield friends. It is said that they are sparing no effort to ensure the success of the approaching meeting, which will be the second at that city, the first having been held in 1859. The location seems well chosen for a convocation of brain workers, as there is probably no other site in the world so closely surrounded by such an array of educational institutions of the highest class within a few hours' ride, including Yale and Harvard, and the new women's colleges.



F. W. Putnam.

The local committee is under the presidency of William H. Haile (not the writer of this article, though his name is pronounced the same, but spelled a little differently). Mr. Haile is prominent in State politics. He has been mayor of Springfield and lieutenant governor of Massachusetts, and was once Republican candidate for governor. His father was formerly governor of New Hampshire. The large number of sub- and associate committees, including six from neighboring colleges, seem to indicate a well-organized system. Prof. Wm. A. Webster is local secretary.

Returning now to Springfield, near the end of this century so pregnant with discovery and invention, and after the lapse of an epoch the most progressive in all history, we may well pause for a retrospect of the first Springfield meeting, held at a time when the most startling achievements of science were only a bright anticipation, brilliant but unsubstantial as a poet's dream. Yet we find there the germ of this latter-day development. The pioneers of this advanced civilization were in that little band. The students of nature, who by their unwearied investigations, paved the way for the scientific triumphs of the age, were among the members of this association. Stephen Alexander presided, the veteran educator who for nearly half a century taught at Princeton, and who within a few months after that meeting was destined to lead the government expedition to the coast of Labrador, to observe the solar eclipse of July 18, 1860. Joseph Lovering was the permanent secretary, a position which he held from 1856 till 1872, inclusive, except for one year's absence. The association had still in active membership Wm. B. Rogers, Joseph Henry, the Baches (Alexander D. and Franklin), the Sillimans, Agassiz, Isaac Lea, John L. Le Conte, Joseph Leidy, Elias Loomis, Hitchcock, Gray, Guyot, Chauvenet Dana, Torrey, Edward R. Tyler, Jeffries Wyman, Spencer F. Baird, Peirce, Chadbourne, the Coffins (J. H. and J. H. C.), J. Lawrence Smith, Robert Hare—all original members; besides Alexander Winchell, F. A. P. Barnard, O. M. Mitchell, J. E. Hilgard, E. W. Hilgard, B. A. Gould, H. A. Newton, Geo. J. Brush, Simon Newcomb, S. H. Scudder, J. P. Lesley, Geo. F. Barker, Sir Wm. Dawson, Daniel C. Gilman, George H. Cook, Alexis Caswell, Henry I. Bowditch.

Probably the youngest member at that time, although this was already the fourth meeting at which his name had been enrolled upon the list, was a lad just out of his teens, who was destined to a long and distinguished career in connection with the association. Frederick Ward Putnam was born at Salem, Mass., April 16, 1839. He studied under Agassiz, and was for several years his assistant in charge of the collection of fishes at Harvard. In 1864 he was put in charge of the museum of the Essex Institute at his native place, and in 1867 was made superintendent of the museum of the East Indian Marine Society at the same place. These were afterward consolidated as the Peabody Academy of Sciences, of which he was made director, which office he retained till 1876. Meanwhile, in 1874, on the death of Jeffries Wyman, he was put in charge of the Peabody Museum of Archæology and Ethnology at Harvard, and in 1886 he became Professor of American Ethnology and Archæology at Harvard, which chair he still fills.

Prof. Putnam was chief of the department of archæology and ethnology at the World's Fair in Chicago in 1893. He was one of the founders of the *American Naturalist*, and has conducted numerous explorations of mounds, etc. His published pamphlets and articles number several hundred.

In 1869 Prof. Putnam acted as permanent secretary of the association in the absence of Prof. Lovering, and on the election of the latter to the presidency of the association in 1873 Prof. Putnam succeeded him as permanent secretary, which office he has filled ever since, and has edited 22 of the 43 volumes of proceedings.

But while, like Tennyson's brook, the permanent secretary goes on forever, the presidency of the association, from year to year, passes to new hands. The retiring and incoming president both occupy conspicuous positions. The annual address is given by the retiring president. This year it is Daniel Garrison Brinton, M.D., LL.D., Sc. D., and his theme is "The Aims of Anthropology."

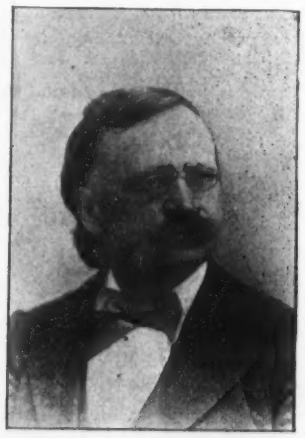
Dr. Brinton was born in Thornbury, Chester County, Pa., May 13, 1837, and graduated at Yale in 1858. He is Professor of Ethnology in the Philadelphia Academy of Natural Sciences, and of American Archæology and Linguistics in the University of Pennsylvania.

Before completing his studies, Dr. Brinton spent a winter in Florida in 1856-57, and there formed a taste for anthropological studies, which in after life he prosecuted so successfully. His early professional life was more occupied with the practice of medicine. After graduating at Jefferson Medical College in 1861, he became a surgeon in the army, and rose to the position of director of his army corps, with the rank of lieutenant colonel. He edited several medical journals, and other medical works. Many years ago he established in Philadelphia a library and publishing house of aboriginal American literature. He received a medal in 1886 from the Société Americaine de France, being the only American who was ever thus honored. He was president of the International Anthropological Congress at the World's Fair in Chicago in 1893.

The president-elect, Edward Williams Morley, M.D., Ph.D., was born at Newark, N. J., Jan. 29, 1838.

He graduated at Williams in 1860, and subsequently taught chemistry. In 1869 he was appointed Professor of Chemistry and Geology in Western Reserve, now Adelbert College, Cleveland, O. In 1873 he was called to a similar chair at the Cleveland Medical College, and still holds both professorships. He has done much excellent work in determining accurate micro-measurements; also in measuring the proportion of oxygen in different portions of the atmosphere, and in ascertaining more accurately the atomic weight of oxygen. In connection with A. A. Michelson, he studied the effect of motion of a transparent medium on the velocity of light. They also devised a method of comparing wave lengths of sodium light with the standard meter, in such manner as to make a more accurate measure of length than any previously known, and thus to obviate the necessity of carefully preserving standard measures, since they can now

Daniel G. Brinton.



E. W. Morley.

at any time be reconstructed. Prof. William A. Rogers subsequently joined in these researches, and has for many years been prosecuting them with Prof. Morley. The apparatus called the interferential comparator is used in these experiments, and is described and figured in the address of Prof. Rogers as president of the section of physics last year, which is published in the volume of proceedings recently issued. Prof. Morley has been spending the vacation this Summer with Prof. Rogers in the further prosecution of these researches, for which the association last year appropriated the sum of $100.

The Invention of the Electromagnetic Telegraph.—III.*

BY J. J. FAHIE.

UNDER date of Sept. 29, 1837, in a petition for a *caveat*, signed Oct. 3, and filed three days later, Prof. Morse states "that the machinery for a full practical display of his new invention is not yet completed, and he therefore prays protection of his right till he shall have matured the machinery." The specification claims as follows: First, a system of signs by which numbers, and, consequently, words and sentences, are signified; second, a set of type to regulate and communicate the signs, with cases for the convenient keeping of the type, and rules in which to set them up; third, a port-rule for regulating the movement of the type-rules, which rules, by means of the type, in their turn regulate the times and intervals of the passage of electricity; fourth, a register for permanently recording the signs; fifth, a dictionary or vocabulary of words numbered and adapted to this system of telegraph; sixth, modes of laying the conductors to preserve them from injury. These several parts are then more fully described. Thus, the signs are representatives of numerals; the register is an electromagnet, actuating by its armature a lever or pendulum carrying a pencil or fountain pen or small printing wheel; and the modes of laying the conductors are by insulating the wires with silk or cotton, wrapping and coating with caoutchouc or other non-conductor, and then enclosing them in iron, lead, or wooden tubes.

For the next three months Messrs. Morse, Vail and Gale, who had before this time became joint partners in the enterprise, were busy in their respective departments. Morse finished his laborious task of numbering a dictionary on Oct. 24; Vail was superintending the construction of new and complete apparatus at his iron works, Speedwell, while Gale was experimenting with batteries and electromagnets at the New York City University. Writing to Vail on Nov. 13, Morse says:

"I arrived just in time to see the experiment Prof. Gale was making with the entire 10 miles of wire, and you will be gratified and agreeably surprised when I inform you that the result now is that with a little addition of wire to the coils of the small magnet, which I had all along used, the power was as great, apparently, through 10 as through three miles. This result has surprised us all (yet there is no mistake), and, I conceive, settles the whole matter."

And again, on Nov. 28, he wrote to the secretary of the treasury:

"We have procured several miles of wire, and I am happy to announce that our success has thus far been complete. At a distance of five miles, with a common Cruickshank's battery of 87 plates (4 x 3½ inches), the marking was as perfect on the register as in the first instance of half a mile. We have recently added five miles more (making in all 10 miles) with the same result, and we now have no doubt of its effecting a similar result at any distance."

On the completion of the new instruments, on Jan. 6, 1838, an experimental exhibition at the Speedwell Iron Works was arranged for a few friends, and on Jan. 11 following, another exhibition was freely opened to the public. It will be remembered that Morse's original instrument was so arranged that its (vertical) lever must necessarily mark a continuous line, either straight or zig-zag, and was incapable of an intermittent dot and dash marking. This was greatly improved upon in the new apparatus, where the marking lever was arranged horizontally (having an up and down movement), with the upright electromagnet under one end, and the moving paper over the other.

About this time Morse, or his partner, Vail,† introduced another great improvement, viz.: the substitution of types representing the letters of the alphabet for the numeral types and numbered dictionary; and on Jan. 24, 1838, at an exhibition in the New York City University, through 10 miles of wire, the words to be telegraphed were set up and recorded in the new alphabetic symbols.

The instrument thus brought to a satisfactory working condition was designed to be sent to Washington for exhibition, and on the way from New York its action, through 10 miles of wire wound on reels, was shown to a committee of the Franklin Institute, at Philadelphia, on Feb. 8. About the middle of February, 1838, Morse arrived in Washington, and exhibited his apparatus to members of Congress and others. He then presented a petition to the government for an appropriation or grant to defray the expense of an experimental line between two cities, which petition being referred to the committee on commerce was favorably reported by the same on April 6: "The committee agree unanimously that it is worthy to engross the attention and means of the Federal Government to the full extent that may be necessary to put the invention to the most decisive test," and in accordance with this opinion, "The committee recommend an appropriation of $30,000, and to this end submit herewith a bill." The bill failed to receive the support of the majority, and a favorable result was not obtained for several years.

Meanwhile Morse was engaged in preparing papers with a view of obtaining patents in America and Europe, and in preaching up his invention. The American specification (signed April 7, 1838) includes, in addition to the several parts described in his *caveat* of Oct. 3, 1837, the recently devised system of alphabetic signs; a rotary port-rule for continuous action, and a combination of circuits or electromagnetic relays. The invention is described as "an application of electromagnetism in producing sounds and signs, or either. It consists of the following parts: First, a circuit of electric or galvanic conductors; second, a system of signs by which numerals and words represented by numerals and thereby sentences of words as well as of numerals and letters of any extent and combination of each are communicated; third, a set of type adapted to regulate the communication of the above-mentioned signs; fourth, an apparatus called the port-rule which regulates the movement of the type; fifth, a signal-lever which breaks and connects the circuit; sixth, a register which records permanently the signs communicated; seventh, a dictionary, or vocabulary of words to which are prefixed numbers; eighth, modes of laying the circuit of conductors.

After filing his application in the Patent Office, in order not to be forestalled in his intended efforts to obtain patents in Europe by his American patent being published abroad, Morse filed a request that its issue might be suspended till his return. Although the favorable report on the memorial to Congress made to the House of Representatives by its committee failed, as we have seen, to secure the appropriation recommended, Mr. Francis Smith, the chairman of that committee, was so well satisfied with the merits of the invention that, on retiring from Congress, he became a partner in the enterprise and accompanied Morse in his voyage to Europe, May 16, 1838. In consequence of the opposition of Cooke and Wheatstone, Morse was refused a patent in England on the grounds that a brief description of the invention had been published.‡ His success in France was practically no greater, for, although a patent was obtained on Aug. 18, 1838, it was rendered nugatory by ingenious legal conditions: First, that the invention must be carried into successful operation in France within two years under pain of forfeiture; and, second, that all private persons, companies or corporations were prohibited from putting a telegraph into operation in France. Thus disappointed in his great, and, it must be said, reasonable expectations, Morse returned to New York, April 15, 1839.

His application for a patent in the United States, which, as we have seen, was filed April 7, 1838, was finally granted June 20, 1840. It now comprised nine claims, as follows: First, the combination of type, rule, lever, etc.; second, the recording cylinder, etc.; third, the types, signs, etc.; fourth, the making and breaking of the circuit by mechanism; fifth, the combinations of successive circuits; sixth, the applications of electromagnets to general levers; seventh, the mode of recording by the use of electromagnetism; eighth, the combination and arrangement of electromagnets in one or more circuits with armatures for transmitting signs; and ninth, the combination of the mechanism described, with a dictionary of numbered words.

Nothing is said in this patent, nor in its re-issue of Jan. 15, 1846, to indicate that signaling could be done by hand; but in another re-issue of June 13, 1848, the specification is changed to say, "and the closing and breaking of the circuit may be effected by applying the hand or any other machinery to the signal lever or by any other mode adopted to the same end." In his "Modern Telegraphy," page 25, Morse says: "At the time of the construction of this first telegraphic instrument I had not conceived the idea of the present key manipulator dependent on the skill of the operator, for I presumed that the accuracy of the imprinting of signs could only be secured by mechanical arrangements and by automatic process."§ The

* Continued from p. 212.

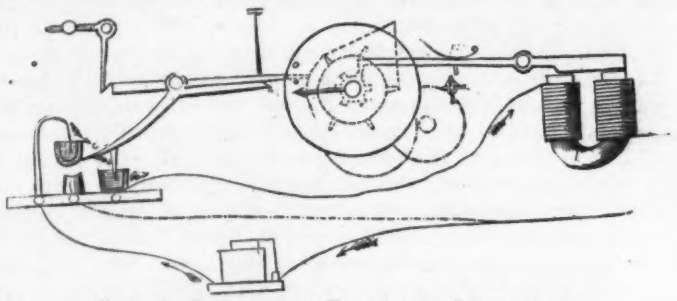
† A vexed question. See "Smithsonian Report" for 1878, Taylor's reprint, pp. 84, 100.

‡ See "Smithsonian Report," 1878, Taylor's Reprint, p. 50, foot note; also Latimer Clark's "Memoir of W. F. Cooke," p. 36, regarding Cooke and Wheatstone's application for an American patent. Clearly Mr. Clark's hint at undue influence on the part of Morse is unfounded and should be withdrawn.

§ For Morse's belief in the "great value" of this arrangement see Turnbull's "Electromagnetic Telegraph," 1852, pp. 49, 50.

Morse "lever" must not, therefore, be confounded with the existing finger key, which appears to have been contrived, nearly in its present form, by Mr. Thomas Avery, a philosophical instrument maker of New York, who was engaged in laying the experimental line between Baltimore and Washington in 1844.

The appropriation asked for from Congress, in February, 1838, though earnestly pressed at successive sessions, failed to obtain sanction until March 3, 1843, when a bill was narrowly* passed, author-



Cooke's Escapement Telegraph Instrument.

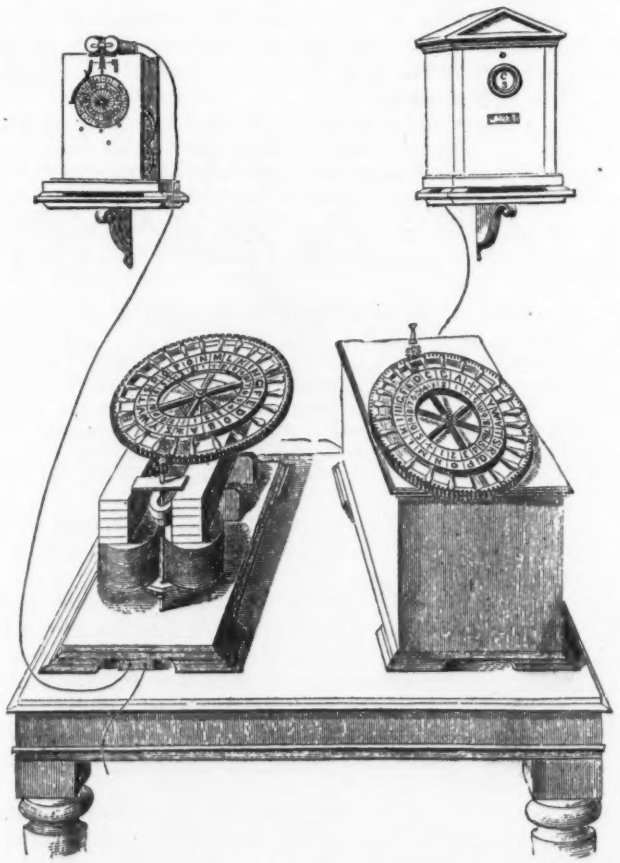
izing an expenditure of $30,000. The stations selected for the experimental line were Baltimore and Washington, about 40 miles apart, and in order to form two complete circuits 160 miles of copper wire, covered with cotton (? No. 16 gauge) were ordered. Before enclosing the wires in leaden pipes, Prof. Morse tried some experiments, which are thus described in his letter to the secretary of the treasury, dated Aug. 10, 1843: "The experiments were tried on Tuesday, and with perfect success. I had prepared a galvanic battery of 300 pairs, in order to have ample power at command, but to my great gratification I found that 100 pairs were sufficient to produce all the effects I desired, through the whole distance of 160 miles. The result, then, of my experiments is that a battery of only 100 pairs will operate a telegraph on my plan 80 miles distant with certainty and without requiring any intermediate stations." As it was part of the original plan (as set forth in the *caveat* of 1837) to lay the wires underground, Prof. Morse, in 1843, devised a method of forming a leaden pipe around the four insulated wires, that is, of introducing the conductors into the pipe in the process of its construction—a method for which he took out a patent Oct. 25, 1843. When several miles of the wire thus prepared were laid by means of a plough cutting two and a half feet deep into the ground and depositing the wire as it progressed, Prof. Gale found that not one mile was sufficiently insulated to carry the current.† The plan was therefore abandoned early in 1844, after more than half of the grant had been expended, and it was decided to remove the wires from the leaden tubing and put them on poles. Different plans of insulating the wires at the points of support were proposed and were submitted to Prof. Henry for his opinion.‡ He decided in favor of Mr. Ezra Cornell's plan of separating the wires as far apart as convenient and attaching each wire to a separate glass insulator. The line was accordingly erected on this plan, and by the middle of May, 1844, was completed from Baltimore to Washington. On the 24th of that month the first formal message, "What hath God wrought!" was sent over the lines and recorded in the dot-and-dash alphabet.

Besides the improvements which we have already noted as having been embodied in Morse's original contrivance of 1837 we may here briefly allude to some others which found their way into the apparatus in its later form. The electromagnet used on the experimental line was a huge thing weighing 185 pounds, and the machine was so heavy and cumbersome that two men were needed to move it about. The coils were 3½ inches long and 18 inches in diameter, the wire (copper) being that known as No. 16, insulated with cotton thread—the same size as the wire used on the line, it being then supposed by Prof. Morse the wire of the coils and of the line should be of the same size! This monster magnet was used for a time and was replaced by another much less in size, made by Prof. Page. This in its turn was soon replaced by another less in size made by Prof. Page. This in its turn was soon replaced by one of the size now in use, which had been bought in France in 1845. Attached to the marking lever were fountain pens devised by Mr. Alfred Vail. To each lever were fastened four pens, which dropped the ink upon the paper, much as in Steinheil's telegraph. There were at first four pens, then three, then two, and finally one. The inking process was, however, soon abandoned, and was replaced by the indenting of the paper by a hard steel point or embosser. As regards the signaling key or lever, and the apparatus generally, Mr. Avery thus speaks in the Bain patent trial in Philadelphia in 1851:

"The instrument for breaking and closing the circuit was crude, consisting of a slip of sheet copper with one end fastened to the table, while the other, being loose, and moving like a spring, was operated by the finger. I invented and made a finger key with a spring and fulcrum, the finger knob being of ivory or pearl for insulating the key and preventing shock. The battery [Groves ?] with siphon tubes was a failure and had to be abandoned. The relay magnets were not sufficiently delicate. I was obliged to alter the journals to work on agate points which made them work with more delicacy, and thereby Mr. Morse was enabled to work with a half quantity battery. The adjustment of the agate points was my own invention. The instrument made for writing never was used, being found totally useless; it was cut up and part of the material used by me for making new improvements. The recording instrument had also to be altered."

The use of the earth as part of the circuit was introduced some time after the opening of the Baltimore-Washington line, as we gather from Vail's "Electromagnetic Telegraph," pages 23–24.

We have left for the last a brief consideration of the Relay principle—a question which has become needlessly vexed by the way in which the friends of rival claimants have treated it. Henry in America was *facile princeps* in his application of it to local circuits.§ Wheatstone in England made the discovery for himself and applied it to repeating or renewing circuits. This was



Wheatstone's Step-by-Step Telegraph Apparatus.

some time between March 4 and April 11, 1837, when he explained it to Henry at their meeting which took place on that day (see my "History of Electric Telegraphy," pp. 510 and 515). In their patent of June 12, 1837, Cooke and Wheatstone use the principle for both local circuits and repeating or renewing circuits. About the same time as Wheatstone, Edward Davy also made the independent discovery, and applied it to four different purposes in his patent of July 4, 1838: First, to discolor or die

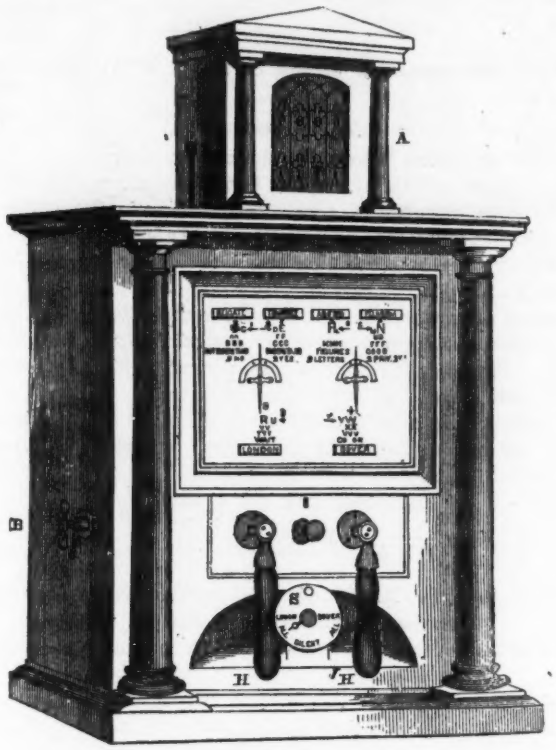
*"When the bill was presented one member moved an amendment requiring half the appropriation to be used for the encouragement of mesmerism; another proposed to include Millerism in the benefits of the grant; others to appropriate parts of the sum to a telegraph to the moon. When the bill came to a final vote this was so close that a change of three votes would have wrecked it." (Prof. Trowbridge, in *The Advance*.)

† See Taylor's reprint, p. 53.

‡ See more in the "Smithsonian Report," 1878, Taylor's reprint, p. 97.

§ Edward Davy was eight years before him in this. See my "History of Electric Telegraphy," p. 356.

the prepared calico or other material on which he registered his signs; second, to actuate the electromagnet which regulated the movement of the calico; third, to direct the main circuit to either



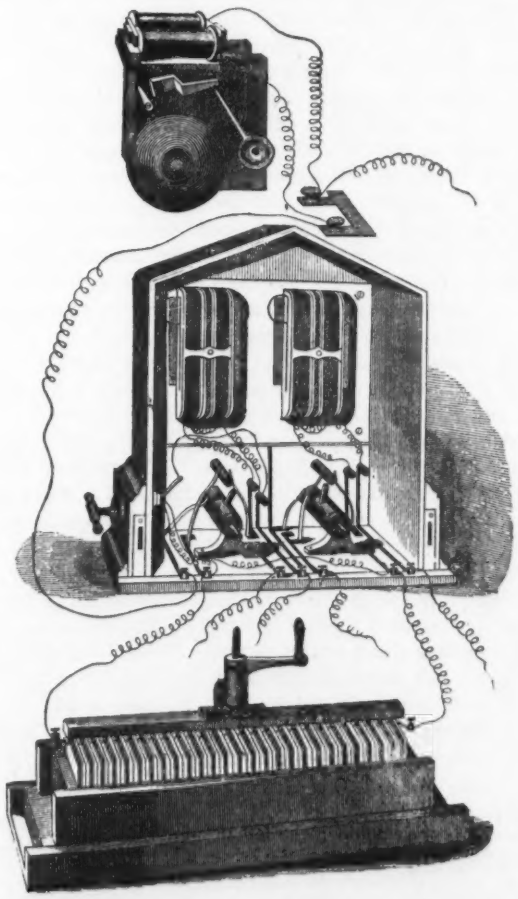
ENGLISH DOUBLE-NEEDLE INSTRUMENT.

of two branches as may be desired; fourth, to repeat or renew the current in a series of long circuits.*

Of Henry's discovery Morse probably knew nothing; while of Wheatstone's and Davy's he could not possibly know anything until June, 1837 and July, 1838, the dates of their respective patents. To Morse, then, we must also accord the credit of its independent discovery, 1836–37, although, as we shall presently see, he did not realize its most important application, viz.: for local circuits until some seven years later, a knowledge which he may have gained from its actual working on the English telegraphs erected in the Autumn of 1837 and onward. We have seen that Morse "conceived" the relay principle as applicable to repeating or renewing circuits some time in 1836; "matured" or rather, "discussed" it with Prof. Gale in the Spring of 1837; omitted to mention it in his *caveat* of October, 1837; and described it in his specification, April, 1838, which description, it should be remembered, was not *published* until his patent issued in June, 1840.† In this connection Morse says:

"The combination of machinery in my telegraph, as put in operation in 1844, was different from that originally contemplated and described in my first patent in the following respects, viz.: The combined circuits of my first patent were the combination of two or more circuits as links in a main line for the purpose of renewing the power and propelling forward indefinitely the electric current in such volumes as to charge an electromagnet with sufficient magnetic force to work a register; and were suggested by the probability indicated by my own experiments and (?) the experiments of scientific men that sufficient magnetic power could not be obtained from the electric current through a very long circuit to make a mark of any sort. This difficulty I proposed to obviate by means of two or more circuits, each with a battery, coupled together and broken and closed by means of the same principles as the receiving magnet now used. These links of one main line were to be made so short as to secure the necessary magnetic power. The register was to be placed, not in a short circuit as now arranged, but on the links in the main line. This arrangement was liable to the practical inconvenience that it would always require two lines of wire, both always in order, since the receiving magnet would work only in one direction.* While preparing to build the line from Washington to Baltimore I ascertained, by experiment upon 160 miles of insulated wire, that magnetic power sufficient to move a metallic lever could be obtained from the electric current of a circuit of indefinite (? very great) length, and that there was no necessity for combining two or more circuits together for the purpose of renewing the power at short intervals on the main line. I then devised the present combination which enables me to work the same wire both ways, thus dispensing with one of the two wires originally supposed to be necessary under all circumstances. This combination consists of one main circuit, connected by the receiving magnet with as many short office circuits as may be desired upon which, respectively, are the requisite registers. This improvement was used on the Washington-Baltimore line for the first time in May, 1844, and was patented April 11, 1846."

After a careful perusal of these pages we believe it will not be difficult to apportion the honors due to the trio of now distinguished men who were principally concerned in the perfecting and launching of the Morse telegraph, and we think our readers will agree with us in the following conclusions: We feel bound at the outset to take exception to the way in which Prof. Morse always spoke of his invention. In his writings and in those of his friends there is an evident effort at antedating, which must produce in the minds of those who read the history of his telegraph as here presented, a painful effect. Moreover, in the way in which, in season and out of season, he asserted his claims, there is an air of exaggeration which is certainly not justified by the facts. With that strong subjectivity and assertiveness which characterized him, Morse always believed his invention to have been, Minerva-like, full-fledged at its conception in 1832, or at least at its birth in 1835-36, quite ignoring the slow and small advances derived from his own experience and the suggestions of others. Even as late as December 1852, he asserted: "The truth is, the child was born, and breathed and spoke in 1835. It had then all the essential characteristics of the future man" ("American Telegraph Magazine," Dec. 15, p. 130). If so, it must surely have been in a sufficiently forward state to have been brought before the secretary of the treasury on March 10, 1837, in reply to his circular of that date calling for such contrivances. If so, why could not Sidney Morse, writing on April 15, and apparently in reference to the treasury circular, have given us something more definite than



INTERIOR AND CONNECTIONS OF DOUBLE-NEEDLE INSTRUMENT.

a vague mention of a telegraph of 26 wires; and if so, why did Morse wait six months, from March 10 to Sept. 27, to formally announce his invention. Our readers will find the reason why in these pages; for

* Compare Davy's thorough grasp of the value of the relay principle, pp. 359, 363, 366, 390 and 395 of my "History of Electric Telegraphy," with Wheatstone's halting belief at p. 515 of the same work.

† See in this connection Dr. Hamel's statement, as ungracious as unfounded, in his "Historical Account," etc., Cooke's reprint, p. 72, foot note.

‡ It is right to say here that Davy's arrangement for the same purpose was open to the same inconvenience, but a little practical experience would have enabled both men so to combine, as has since been done, two sets of instruments at the repeating station as to require only one line wire, or one set.

if our history proves anything, it shows that Morse's conception of 1832 (which we grant, for we see no reason to dispute it), first, was not born until 1836, and probably late in the year; second, was a very rickety creature early in 1837, when the doctor, Prof. Gale, was called in, and found that it could not speak through even a few yards of wire; third, was slowly set on its legs (still shaky) in the succeeding months by Gale's application of Henry's nostrums; and fourth, was fostered to maturity by the help of Gale, Henry, Vail and others. To us the evolution of Morse's telegraph appears to be somewhat as follows: His conception of 1832 (1) was quickened about 1835-36 by accounts of Gauss and Weber's, and (the earlier) Steinheil experiments;* (2) was prematurely delivered in the Spring of 1837, its birth being probably hastened by the treasury circular of March 10; (3) was in the succeeding months forced into some shape under the spur of hints of the like occurrences in Europe which kept provoking by appearing in the American papers; and (4) was, in order to secure priority, hurried into public notice in September, with all its imperfections, but with the promise of a more complete form by Jan. 1, 1838.

As to how much Morse borrowed from other laborers in the same field it is difficult to say, but we are inclined to think it was very little. It is admitted that he knew nothing for a long time of Henry's discoveries which were so vital to the success of his project. Similarly of the labors of Cooke and Wheatstone, † Davy, Alexander and others he could know nothing until, say, the Summer of 1837, by which time his own fledgeling was growing up. Of Steinheil's earlier experiments he probably knew something from his trial of fountain pens, but of his later experiments and discovery of the earth circuit Morse was evidently ignorant until after the opening of the Baltimore-Washington line in 1844.

Morse's claim to be the first and original user of the electromagnet for telegraphic purposes can hardly be maintained, seeing that both Henry, in America, and Booth, in Ireland, suggested it some years earlier, and actually showed in their lectures how to apply it. But to Morse alone belongs the idea, the conception, as he so often calls it, of his own particular application, and that this idea was good and admirable we see by the fact of its realization having survived the fierce struggle for existence, and of its being used to-day in every part of the world, confering immortality on the name of Morse. We must also give him full credit for large faith in the potentialities of his idea, and for the perseverance with which, under sneers ‡ and difficulties and disappointments of all sorts, he sought for years to realize his plans. Of the necessary scientific knowledge he had little, as we see from his own writings *passim*, and from the statements of Profs. Henry and Gale, than whom none are more able to form an opinion.

But faith and perseverance alone would never have enabled Morse to make his ideas practicable. To his scientific assistant, Prof. Gale then, we are in the next place indebted for the application of certain principles of electromagnetism, the discovery of which we owe to the genius of Henry, who, be it remembered, had himself pointed out their applicability. Morse has handsomely admitted his obligations to Prof. Gale when he says: "To him I am most of all indebted for substantial and effective aid in many of my experiments, and if any one has a claim to be joint inventor with me on the score of aid by hints, it is Prof. Gale." (Taylor's reprint, p. 57.)

Mr. Alfred Vail's services, though perhaps of a more everyday kind, were no less necessary to the successful launching of the telegraph as a commercial enterprise. "His means, zeal, and mechanical skill" (to use Prof. Gale's words), were of the greatest value at a critical moment to the fortunes of the telegraph, and Morse showed his appreciation thereof in a very tangible way, viz.: By admitting Vail to a share of the patent. To sum up, then, in brief: Firstly, Morse has credit for the idea and for the large faith and persistency with which he labored at it; but, secondly, without Henry's discoveries and their application by Prof. Gale the idea would never be practicable; and thirdly, without Vail's devotion and mechanical skill the idea would never be commercially successful. To these men, therefore, severally and jointly, must be awarded the honors of the invention and introduction of the Morse telegraph—a conclusion to which, we believe, every attentive reader of these pages will say amen.

* For which, as for others, see my "History of Electric Telegraphy."

† In his memoir of Cooke, in the "Journal of the Institution of Electrical Engineers," Mr. Latimer Clark says: "It is sufficiently evident that the American (Morse) telegraph grew out of the efforts of Cooke and Wheatstone and other European telegraphers, and that there is no ground for that claim of priority which it has sometimes been endeavoring to set up." We think this statement is altogether too sweeping, and is certainly wrong as regards any indebtedness of Morse to Cooke and Wheatstone, save, perhaps, as regards the value of the relay principle for local circuits, of which he would have learned equally well from Davy.

‡ Mr. George Vail, in his evidence before the commissioner of patents in 1854 says: "The great mass of intelligent men regarded the magnetic telegraph as a mere visionary scheme from which nothing useful could ever be realized. Prof. Morse was looked upon as a clever and ingenious man, but scarcely of sane mind."

The Determination of the E. M. F. of Alternators.

BY R. P. BROUSSON.

To the writer's own knowledge students and even some electrical engineers have a very hazy idea as to why an alternator with absolutely the same number of conductors, magnetic flux and speed as a continuous-current machine of the same general type, yet gives under certain conditions a higher effective alternating E. M. F. than the E. M. F. the continuous-current machine produces.

The object of this article is, therefore, to show how the E. M. F. of any alternator running on open circuit can be obtained when the speed of rotation, the magnetic flux, and the shape and relative dimensions of the armature coils and field poles are known.

First taking the case of the E. M. F. of a continuous-current machine, the ordinary formula is derived straight from the fundamental definition that one volt is generated in a conductor when cutting 10^8 C. G. S. magnetic lines per second.

$$E = \frac{S \Phi R P 10^{-8}}{Y} \qquad 1$$

where E = The E. M. F. of any continuous-current machine whether bipolar or multipolar.
S = Total number of conductors on external surface of armature.
Φ = Magnetic flux through one pole in C. G. S. units.
R = Number of revolutions of armature per second.
P = Numbers of pairs of poles.
Y = Number of pairs of parallels or bifurcations of the armature circuit.

For an alternator the formula becomes modified to:

$$E\varepsilon = \frac{K S \Phi R P 10^{-8}}{Y} \qquad 2$$

where K = a constant for each machine.

$E\varepsilon$ being the effective E. M. F. of the alternator, when S, Φ, R and P signify the same as in formula 1. $R P$ thus equals the number of complete alternations per second. In a continuous-current bipolar machine the value of Y is usually 1, but in an alternator the usual practice is to connect all the armature coils in series so that the value of Y is then 0.5.

With the exception of the constant K the two formulæ are identical. The value of the constant K can vary between wide limits, the minimum value being about 0.58, and the maximum value 1.5; the constant for the majority of commercial alternators is usually somewhere about 1.15.

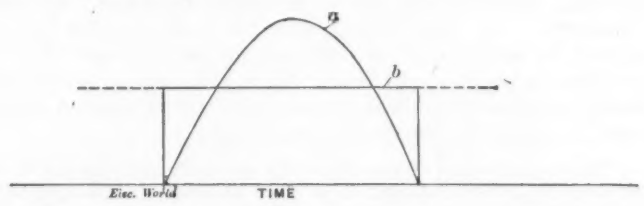


FIG. 1.

It is commonly stated that if the shape of the alternator wave follows the sine law then the constant is 1.1, but this statement must be accepted with reservation, as it is only true when the area of the instantaneous values of the alternating E. M. F. plotted against time is equal to that of the continuous-current machine.§ (See Fig. 1.)

It is quite possible to have an alternator of such a form that the

§ That is to say, if the currents a and b, a, of course, being rectified, are employed for electroplating, each will deposit the same amount of metal under suitable conditions in a given time. If, however, the two currents are employed for lighting incandescent lamps, where the heating property of the current comes into play, the effects are no longer the same because the heating depends on the square of the current. Thus the square root of the mean square of the alternating E. M. F., that is, the effective E, is 1.1 times greater than the continuous E simply because it is a question of a mean of the $(\text{sine})^2$ values and not of a mean average value of a simple sine curve. The average ordinate of a sine curve whose maximum is taken as unity is 6.737, that of a $(\text{sine})^2$ curve is 0.707.

$$\frac{0.707}{0.637} = 1.1.$$

value of K is quite different to 1. 1, and yet have a wave shape which follows the sine law. The constant K depends solely on the configuration of the magnet poles and armature coils, and can be determined either experimentally or by the following treatment.

Considering, first of all, the most simple case, namely, that of a two-pole armature, in which the winding is connected to both alternator collecting rings and to an ordinary continuous-current commutator. To obtain the alternating wave shape it is necessary to make an outline drawing to a suitable scale of the pole-pieces and armature. (Fig. 2.) This should be done on fairly stiff paper, as it is necessary to cut the armature out so that it can be revolved between the poles. Next divide the pole faces up into any convenient number of subdivisions, say 20, assuming the pole angle is 120 degrees. Secondly, divide the armature up into a certain number of sections, say 60, independent of the number of conductors.

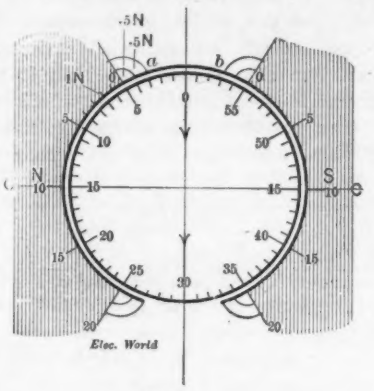


FIG. 2.

There are thus at any instant 20 sections under the poles. Thirdly, to make allowance for the magnetic fringing at the edges of the poles allow as in figure. Then assuming the strength of field of each subdivision of the pole itself as unity, the relative strength of field of the two subdivisions of the fringe may be taken as 0.5 and 0.25. This is a somewhat arbitrary arrangement, but is obviously better than taking no fringe at all. The object of so dividing the armature and poles is to obtain the shape of the alternating wave, and thus be able to obtain the ratio of the maximum instantaneous E to the effective E. Obviously the maximum instantaneous E is obtained when the connections to the alternator rings are turning between the angular distance ab, and the zero E when the connections are horizontal at C, where the E due to the coils between ac exactly equals and opposes that due to the coils between b, c.

The maximum instantaneous E may be considered as proportional to $20 + 2(0.75) = 21.5$. Starting from the vertical position and moving the armature round through 90 degrees by a section at a time, ($\frac{1}{60}$ of armature periphery), it is possible to obtain figures which are proportional to the instantaneous E's in those various positions. For instance, when the armature connection is at position 7 from the vertical the instantaneous E is proportional to 18.0.

The figures for the various positions and their squares are as follows:

Position.	Inst. E.	(Inst. E)^2.
0	21.5	462.0
1	21.5	462.0
2	21.5	462.0
3	21.5	462.0
4	21	440.0
5	20	400.0
6	18	324.0
7	16	256.0
8	14	196.0
9	12	144.0
10	10	100.0
11	8	64.0
12	6	36.0
13	4	16.0
14	2	4.0
15	0	0.0
	217.0	3824.0

$$\frac{3824}{16} = 239 \quad \sqrt{239.} = 15.5 = \text{Effective } E;$$

$$\text{Average } E = \frac{217.}{16} = 13.5;$$

Maximum alternating $E = 21.5$.

Thus, when the maximum alternating E is represented by the figure 21.5, the average E will be proportional to 13.5 and the effective E to 15.5. Having obtained this ratio the next thing to do is to find the rates of the continuous E to the maximum alternating E. The instantaneous continuous E, which is also the terminal E, is due to the active conductors under the poles and fringe at any instant, and in fact in this case must be equal to the maximum alternating E, because the manner in which the conductors are grouped on the armature surface is the same as well as all other conditions.

Thus the value of K for a two-pole continuous-current armature, when used as an alternator, is $\frac{15.5}{21.5} = 0.72$ when the pole angle is about 120°. As another example take the case of an ordinary alternator such as one of the Westinghouse type. The dimensions of the armature coils and poles relatively to the pitch (the pitch being the distance through which the armature coil has to move to give one complete positive or negative wave) being as follows:

Width of pole = 0.5 pitch.

Breadth of armature coil = pitch.

Breadth of copper in coil = 0.5 pitch.

Then dividing the poles and armature coils up into sections as before, say 20 sections each for both armature and poles. In the position shown (Fig. 3) the maximum E will be generated and will be represented by the number 20.0.

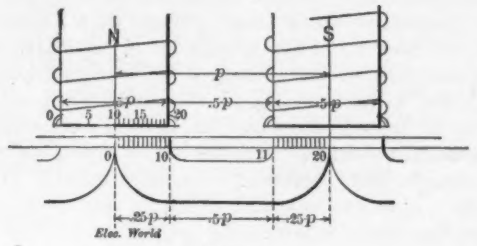


FIG. 3.

The zero E will be obtained when the centre of the coil has been moved to the position 2 shown in Fig. 3. It is thus possible, by moving the coil from position 1 to 2, to obtain a series of figures representing the instantaneous E's in various positions and from them obtaining the wave shape. Briefly, the result obtained is that when the maximum inst. E is represented by 20.0, the average E will be equal to 10.65, and the effective E to 12.15. As before, the next point to consider is, what relation does the maximum alternating E bear to the E obtained when the machine is used for continuous currents? The number of armature conductors will remain the same, but will be spread evenly over the whole armature surface, instead of covering only half the surface, as in the alternator.

The field poles having the same dimensions as before can therefore only influence at any instant slightly over half the total number of conductors. It is evident that if there were no fringe to be considered their influence on the E. M. F. would be exactly halved. The continuous instantaneous E or terminal E will therefore bear to the maximum alternating E the ratio of 10.75:12.15. The ratio of the continuous E to the effective alternating E will thus be as 1:1.13 which gives K as required.

Particulars of Type.	K calculated.	K as given by Mr. Kapp.	Ratio of Effective to average E.
1. Pole width = 0.5 pitch. Breadth of coil = pitch. Copper in coil = pitch.	.8	.817	1.11
2. Pole width = 0.5 pitch. Breadth of coil = pitch. Copper in coil = 0.5 pitch.	1.13	1.15	1.16
3. 2-pole machines as an alternator. Pole angle 120°. Coils covering whole surface.	.72		1.15
4. Pole width = 0.33 pitch. Breadth of coil = pitch. Copper in coil = 0.33 pitch.	1.41	1.4	1.38
5. Pole width = 0.65 pitch. Breadth of coil = pitch. Copper in coil = 0.5 pitch.	1.06	1.03	1.17
6. Pole width = pitch. (All N-poles on one side of armature.) Breadth of coil = pitch. Breadth of copper = 0.5 pitch.	.731	.81	1.13
7. Sine alternator. (See previous foot note.)	1.11		1.11

Pole width = 0.62 pitch in Mr. Kapp's machine.

By the method described it is easy to obtain the constant K for determining the E. M. F. of an alternator on open circuit, whatever the type and whatever the shape of field poles and armature coils. The shape of the alternator waves so obtained is more angular than

occurs in actual practice, but as the various figures are averaged the result is sufficiently accurate.

The foregoing values of K for several types of alternator have been calculated and for the sake of comparison the values obtained by Mr. Gisbert Kapp are also given. It will be seen that there are only very slight differences between the two sets of figures. In the method here given it has been assumed that the field in the pole gap is uniform, which is an assumption that hardly holds good in practice even when the machine is on open circuit. Nevertheless the gap field in a well-designed machine on open circuit will be very nearly, if not quite, uniform.

The values of K given above are all on the assumption that the active part of the armature conductors are parallel to the pole edges. If the coils or the field poles were rounded or irregular in shape, so that the conductors entered the field more gradually, it is still possible, although at the expense of a little more trouble, to calculate K with very fair accuracy.

Electrodynamic Machinery.—XLV.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

331. Any continuous-current electric motor will supply a constant torque at a constant speed when operated at a constant pressure. Thus, whether the motor be self-excited or separately-excited, and whether it be shunt-wound, series-wound or compound-wound, it will, if supplied with a constant pressure at its terminals, and assuming constant frictions in the machine, deliver a constant torque at a constant speed, and taking from the mains supplying it, a constant current strength, and, therefore, constant activity. The condition of constant torque and constant speed is one which is, therefore, readily met by electric motors.

The above statement, however, is true only of single motors, for, if two motors of any continuous-current type be connected in series across a pair of constant-potential mains, they will be in unstable equilibrium as to speed under a given load. If the torque on each of the two machines in Fig. 208 were maintained absolutely equal,

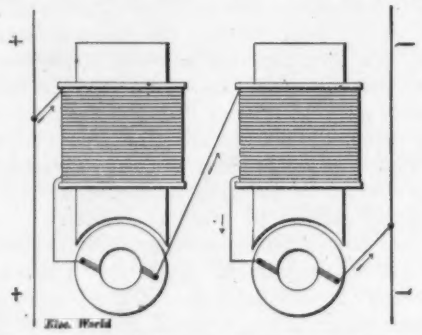


FIG. 208.—TWO SERIES-WOUND MOTORS. COUPLED IN SERIES BETWEEN CONSTANT POTENTIAL MAINS.

then by symmetry, the two series motors represented would run at equal speeds, and absorb equal activities. But should the load on one accidentally increase, even to a small extent, above that of the other, the tendency would be to slow down the over-loaded motor and accelerate the other, so that it would be possible to have one motor at rest exerting a constant torque, and the other motor exerting the same torque at double its former speed. If, however, the two motors are rigidly coupled together to the countershaft, so that their speeds must be alike, then they will behave as a single motor. Consequently, a continuous-current motor employed for pumping or driving a fan, and which, therefore, has a constant torque to supply, will run at constant speed when supplied with constant pressure, whatever the type of motor may be.

332. The important requirement of constant speed under variable load is nearly met by a shunt-wound motor. It may be almost perfectly met by the compound-wound motor. It is not met, without the aid of special mechanism, by the series-wound motor.

333. Considering first the case of a shunt-wound motor, represented in Fig. 159, the speed at which the armature will run is $\frac{E}{e}$ revolutions per second (Sec. 294), when at no load, provided that the friction of the machine is so small that we may safely neglect the drop of pressure in the armature running light. When the full load current I amperes passes through the armature, the speed will be reduced to $\frac{E - Ir}{e}$ revolutions per second, r being the armature resistance in ohms.

Thus a particular shunt-wound, 110-volt motor has an armature resistance (hot) of 0.075 ohm, and its full-load output is 9 H.P. What will be its fall in speed between no load and full load, its no-load speed being 1,395 revolutions per minute or 23.25 revolutions per second?

Here neglecting the armature torque and drop in pressure at no-load, e, the dynamo power, or volts per revolution per second $= \frac{110}{23.25} = 4.73$. Its output at full load being $9 \times 746 = 6{,}714$ watts, and its armature efficiency, say, 0.84, the armature intake will be $\frac{6714}{0.84} = 7{,}994$ watts $= 72.68$ amperes $\times$ 110 volts. The full-load armature drop will, therefore, be $72.68 \times 0.075 = 5.45$ volts, and the full-load speed $\frac{110 - 5.45}{4.73} = 22.1$ revolutions per second approximately $= 1{,}326$ revolutions per minute.

The drop in speed of this motor between no load and full load is, therefore, 70 revolutions per minute, or approximately five per cent.

334. If the variation of speed due to the drop in the armature with the full load current is greater than that which the conditions of driving permit, then means may be adopted to reduce the value of e at full load in the above formula, so as to increase the speed in compensation for the necessary drop. This is frequently accomplished by inserting resistance in the circuit of the field magnet so as to reduce its M. M. F., and, consequently, the useful flux which it sends through the armature. A rheostat in the shunt field circuit enables, therefore, such regulation to be made by hand as will maintain the speed of a shunt motor constant under all torques within its full load. For most commercial purposes the automatic regulation of the shunt motor is sufficiently close, the rheostat only being employed on special occasions. The larger the shunt motor the less the drop in speed which is brought about by the full-load current. Thus a 1-H.P. motor will usually drop only 10 per cent. in speed at full load, a 10-H.P. motor 5 per cent. and a 50-H.P. motor 3 per cent.

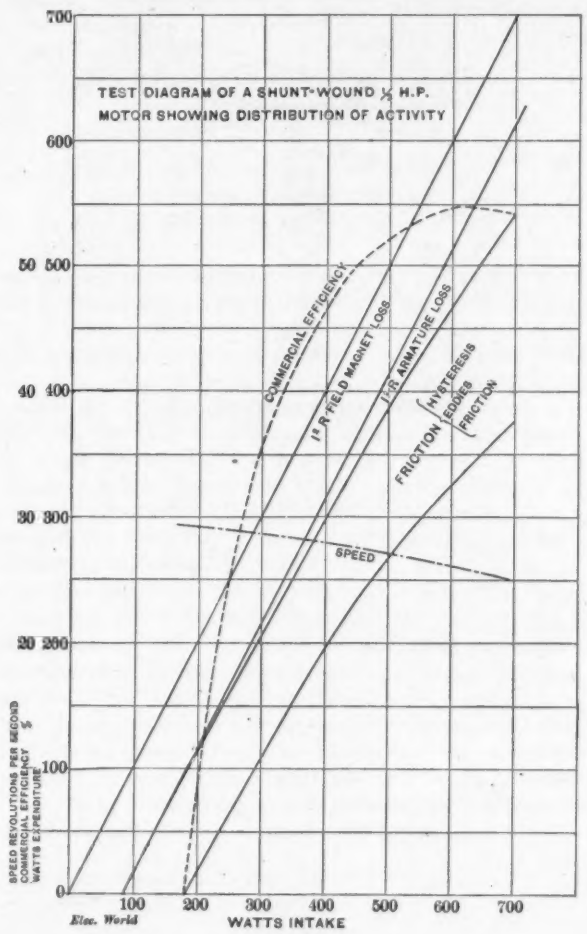


FIG. 209.

335. When a series-wound motor is employed across constant potential mains, in the manner indicated in Fig. 158, the value of e, the dynamo power or E. M. F. per revolution per second, being equal to $\Phi\ w$, varies with the torque or load, since any change in the current strength through the armature changes the M. M. F.

of the field magnets, and, therefore, the flux Φ. The tendency of a series motor is, therefore, to reduce its speed, as the torque imposed upon the motor is increased, and such a motor would run, theoretically, at an infinite speed on light load, if there were no frictions in the armature to be overcome. A shunt-wound motor, therefore, tends to drop in speed with load to an extent proportional to the drop of pressure in the armature. A series-wound motor falls off in speed with load, not only owing to the drop of pressure in the armature, but also owing to the increase in M. M. F. and flux.

336. A compound-wound motor will, however, maintain its speed practically constant under all loads, if the series winding on the field coils be so adjusted that the increase in current strength through these coils and the armature shall diminish the M. M. F. of the field magnets to the degree necessary to compensate for the drop of pressure in the armature winding. The connections of such a compound-wound motor are the same as for the compound-wound dynamo in Fig. 160.

337. Although a series-wound motor is unfitted for maintaining a constant speed on constant potential mains with variable torque, yet it is possible to connect two series-wound machines of the same type and character together, one acting as a generator and the other as a motor, and to obtain a nearly constant speed of the motor by compensatory changes in the E. M. F. of the generator automatically brought about by the variations of load. This case, however, can only apply to a single motor driven by a single generator, and is, therefore, inapplicable to a system of motors driven by a single generating source.

338. Figs. 209 and 210 are diagrams taken from actual tests of two small 500-volt, ½-hp motors of good construction and well-known manufacture, one being a series-wound motor and the other a shunt-wound motor. The armatures of the two machines and also their field frames were practically identical, the only essential difference between the two being in the field winding. The weight of the machines was 105 lbs. each, that of the armature nearly 22 lbs. The resistance of the armatures was 40 ohms each, and the resistance of the fields 3,680 ohms for the shunt-wound, and 37.5 ohms for the series-wound machine.

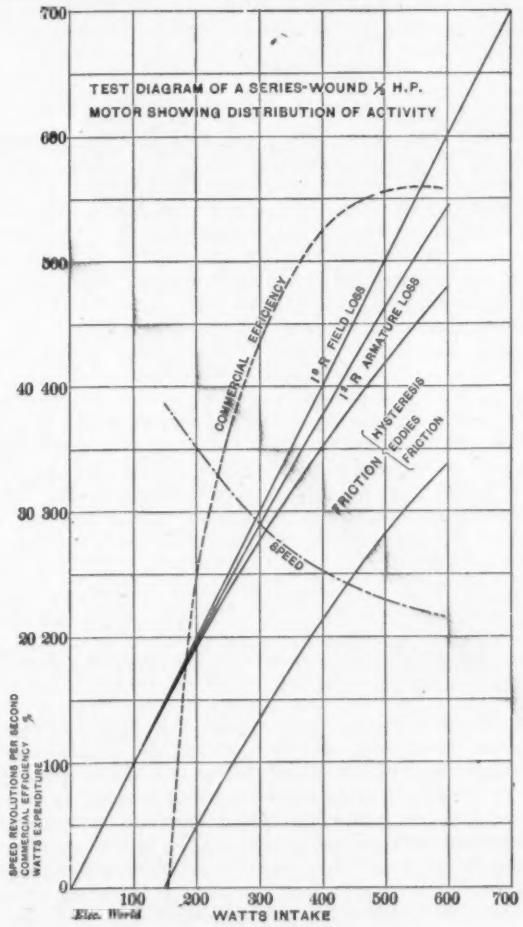


FIG. 210.

In these diagrams the ordinates represent the expenditure of activity in the field windings, armature windings, frictions (including hysteresis eddy currents, and mechanical frictions) and output at the shaft. The abscissas represent the intake in watts. Thus, referring to Fig. 209, for the shunt-wound machine, it will be seen that when delivering full load, or 373 watts, the machine absorbed 690 watts, expending 90 in the field magnets, as I^2R, 67 watts in the armature as I^2R, and 160 watts in total frictions. The commercial efficiency of the machines at full load was, therefore $\frac{373}{690}$ or 54 per cent. The speed of the machine falls from 29.2 to 25 revolutions per second, or from 1,752 to 1,500 revolutions per minute, a drop of 14.4 per cent., and this drop is closely proportional to the output. The highest commercial efficiency reached was 55 per cent. at 340 watts output.

Taking now the series-wound machine referred to in Fig. 210, it will be observed that the field loss is much smaller, particularly at light loads, owing to the fact that it increases with the current strength and disappears when the current is cut off the armature. Owing to this fact it will be observed that the commercial efficiency of this machine is greater throughout than that of the shunt machine. At a delivery of 340 watts, the intake was 600 watts, expended as follows: 57 watts in the magnets, 63 in the armature and 140 watts in frictions. It will be seen, however, that the speed falls from 38.5 to 21.5 revolutions per second, or from 2,310 to 1,290 revolutions per minute, a drop of 44.2 per cent. It is clear, therefore, that a series-wound machine is, in small sizes, cheaper to construct than a shunt-wound machine, since it employs only a few turns of coarse wire instead of many turns of fine wire in its field coils. It also has a slightly higher efficiency. It also dispenses with the use of a starting rheostat in the armature, but has the disadvantage of possessing a much greater variation in speed under variations of load.

(To be continued.)

Laboratory of Houston and Kennelly, Philadelphia, Pa.

The Niagara Falls Plant.

Some letters to the London *Times*, by Prof. George Forbes, with reference to the Niagara Falls plant, are reprinted in the London *Electrical Review*, in one of which he says: "My solution of the problem lay in (1) the selection of alternating currents, and (2) the reduction of speed of alternations as low as was possible, and (3) additional safety was insured by my refusal to allow live circuits to be suddenly opened or closed. If this last policy be not continued, the directors will have themselves to blame for trouble which must arise. At the time when I decided upon alternating currents (which had not then been practically used for power purposes) many predicted failure, and some (including my friend, Lord Kelvin) have continued to do so. Again, when I adopted low frequency, it was so generally condemned, that I claim some foresight in having recognized its merits. I predicted low cost, high efficiency and increased safety as the results of low frequency, and in practice I have been altogether confirmed. The price charged (with handsome profit) is half a farthing per Board of Trade Unit, for which the English companies (under more difficult conditions, it is true) are charging about 6d., and from the time of the inception of this gigantic and novel plant until its commercial working at the present time there has not been a single hitch or mistake to correct. The Niagara Company makes a greater profit by not going to great distances, as it costs them less to supply it near at hand. There is no difficulty or experiment in going to great distances; it is merely a question of expense and of the value of power at the place to which it is transmitted. There are plenty of places in the world where it will pay well to carry the electrical energy 400 to 500 miles. I have no hesitation in saying that the low cost and perfect success, practically and commercially, of the Niagara Works, opens a new era in the world's industrial evolution." To this Lord Kelvin replied that "This is not correct so far as the inclusion of my name is concerned. It is true that I advised the directors not to adopt the method of alternate currents; and the correctness of my advice is now illustrated by the fact that in the first practical use of the power it has been necessary to transform from alternate current to continuous current, for the electrolytic smelting of aluminum. In giving my advice to the directors I told them that they would certainly succeed with alternate current, but much better with continuous current." In a subsequent reply Prof. Forbes states that if Lord Kelvin had referred to his letters he would not have written the above; in a cablegram in 1892 he (Kelvin) declared that the policy of using alternating currents was a fatal or disastrous mistake; Prof. Forbes states that it would have been impracticable to distribute to all customers a 150-volt continuous current, showing that currents of various voltages up to 10,000 would be required for different purposes. "Nearly every one will now admit," he writes, "that the alternating current alone solves the problem well and economically,"

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

Note.—Typewritten copies of any of the articles referred to in the Digest, will be furnished at the rate of 5 cents per 100 words for English matter, and 8 cents per 100 words for matter in foreign languages; translations at the rate of 40 cents per 100 words. Copies of any of the journals may be ordered; address Branch Office, ELECTRICAL WORLD, No. 927 Chestnut Street, Philadelphia, Pa.

DYNAMOS, MOTORS AND TRANSFORMERS.

Behavior of Transformers Under the Influence of Currents of Different Wave Forms.—A very long paper by Dr. Roessler read at the recent annual meeting of the German Electricians, is reprinted in full with a large number of illustrations and tables in the "Elek. Zeit.," Aug. 1, and in brief abstract without the illustrations in the "Lond. Eng.," Aug. 9. He refers to the recent sine wave controversy in THE ELECTRICAL WORLD and London "Electrician" and as the question is such an important one he undertook to make a large number of researches, which are the subject of the paper; he gives the results as also a theoretical discussion on the subject. The apparatus and methods are described in detail; two dynamos were used, one a four-pole Ganz machine which gives a very pointed curve and the other a Wechsler machine which gives a nearly true sine curve. Among the most important results arrived at the following may be mentioned: For the same primary voltage and same output of the transformer, the primary current and the primary consumption of energy are less, and therefore the efficiency greater, with the pointed curve, but the self-regulation of the secondary voltage is somewhat better when the sine curve is used; the differences are especially large for small loads; at no load the primary winding when running with a sine curve takes 1.5 times as much energy and 1.5 times as much current as when the pointed wave is used; the form of the voltage curve can therefore be of extreme importance in the efficiency of a transformer installation; even with large outputs of the transformer the differences will be quite great; the form of waves of current and voltage were determined and are given. The difference between the total losses in the iron for different curves depends only on the differences in the hysteresis losses. The above results refer to an external load of incandescent lamps and their effect with loads containing inductive resistances can readily be deduced. In summarizing the results he states that the use of pointed curves, so far as they refer to the consumption of energy and the primary current, gives by far more favorable results than the use of sine curves or those still flatter; the differences such as he found would be of the greatest importance in transformer installations; an objection to the pointed curves is the larger loss in the secondary voltage; the percentage difference of this voltage was considerably smaller than the difference in the primary currents and power and will not be a great drawback to the use of pointed curves, when a number of transformers can be regulated together from a central station. A much more important condition arises in considering the insulation and this is in favor of the latter curves; for the same mean value of the voltage the maximum was two and three times as great for the pointed as for the sine curves; for the same maximum voltage a much smaller value for the mean should therefore be used for the pointed curve; this is an important objection to their use; he works out an example based on an equal maximum voltage and finds that the cost of transmission of the energy is for all loads quite appreciably higher for the pointed curve, when the insulation in the circuit is to be subjected to the same voltage. In general, therefore, the question must be decided by the load factor and the length of the circuit; if during the greater part of the day the load reaches only a small portion of the maximum for short distances, that is in case of a station near a city, which supplies power and light to many consumers, then the use of pointed curves will probably be the most economical, but for transmission of power to great distances the use of flat curves would be more advisable. These results refer to transformers alone; the smaller amount of light from arc lamps when pointed curves are used is an additional point in favor of flat curves; conclusions for all cases can be arrived at only after experimental researches have been made with the action of motors with the different curves. By pointed curves he means those, a portion of whose ordinates are appreciably greater than all the others and not necessarily curves having an actual point. By properly forming the curve the objections regarding the insulation can be appreciably reduced without sacrificing the valuable properties of such curves. Incandescent lamps are independent of the curve of the current if the average mean square value of the current is the same, but the light from the arc lamp depends very materially on these curves, it being greater as the current retains its maximum value, that is, the flatter the curve.

Effect of the Wave Form on Transformers.—The "Elek. Zeit.," Aug. 1, contains an article by Mr. Feldman in which he discusses the effect of the form of the wave of E. M. F. on the open circuit losses in transformers. He refers to the recent sine curve controversy in THE ELECTRICAL WORLD and the London "Electrician"; in the present article he examines more in detail the changes in the open circuit losses caused by the wave form; he calls attention to the deformation of the open circuit current which will take place even when the E. M. F. follows a sine curve; that current will have a sine form only if the permeability is constant for the whole cycle and if there are no hysteresis losses, but neither of these conditions exist in practice; he discusses the subject graphically with the aid of a number of curves and shows that in a certain case a transformer with the same impressed E. M. F. will, when the curve is pointed, have 4.8 per cent. less open circuit loss, than when it is not pointed, and about 3.5 per cent. less than with an E. M. F. wave of sine form; the same result was found experimentally by Steinmetz; he (Feldman) also found that deformation caused by the transformation of the flat curve increased the open circuit loss 3.7 per cent. and for the pointed curve diminished is about one per cent.; as the secondary E. M. Fs. are deformed much more than the primary they will differ still more in their effect on the amount of open circuit losses as differing from that due to true sine curves.

LIGHTS AND LIGHTING.

Horizontal Carbon Projectors.—In a short article by Mr. Pochin in the Lond. "Elec.," Aug. 9, he points out the advantages of horizontal carbons. Inclined carbons possess many good points but have important defects due to the inclined arrangement; a very large proportion of the light falls on the sides of the projectors and is wasted; he gives a rough idea of this by calculating the loss mathematically and finds that it is about 62 per cent., of which a further 8 per cent. is lost by the obstruction of the carbons; thus the total efficiency of the system is only about 35 per cent. He then describes the Crompton projectors with which he has made many photometric measurements showing that the arrangement is about 2.5 times as efficient as the usual pattern of projector of the same size; similar results were obtained with the Schuckert projector; this does not mean that a projector will give nearly three times as strong a beam as an ordinary one worked at 100 amperes, as the mirror is much closer to the arc and would be in danger of being injured; it should be explained by saying that with about 45 amperes a beam can be obtained whose intensity is 25 per cent. greater than that of an ordinary 100-ampere projector, thus there will be a saving in the dynamo, engine and fuel of 50 per cent. for the same candle-power. In the apparatus described the arc is maintained at a constant length by an electromagnetic trembler, as a shunt across the arc.

Arc Light Carbons.—According to the "Elec. Tech.," July 15, Mr. Cabirau, of Paris, makes carbons consisting of a solid core surrounded by a tube of the same material leaving an air space between the two, which is said to diminish the consumption of the carbon; the tube and core are held together by longitudinal ribs.

Counter E. M. F. in the Arc.—"Elec. Power" for August contains a paper by Mr. Freedman giving the results of an experimental investigation, which was intended to show whether or not there existed a counter E. M. F. in the arc. Tests were made with a number of different metals and with carbon, the voltage for different lengths of arc being measured, the current being kept at one ampere and in some tests at two amperes; the results are given in tables and curves; each material apparently follows a law of its own; an attempt is made to determine the constants in an equation, and it is found that the constants have different values for each current, and have no real physical meaning. He arrives at the following conclusion. There is a counter E. M. F. in the arc depending on the material of the electrodes and its temperature of volatization, and this counter E. M. F. has a constant, definite value for that material; it represents the energy necessary to vaporize the electrode; on account of the different temperatures there must be a thermoelectric effect between the material and its vapor; the counter E. M. F. due to this depends on the difference of temperature between the electrodes, and it must therefore increase with the length of the arc as the temperature of the negative electrode falls, and it must decrease with the current as the temperature of the negative electrode rises; it is fair to assume that the quantity of material vaporized is proportional to the current and that the resistance is inversely to the quantity of material and therefore the product

of the current and the resistance would remain constant if the temperature remains the same, but as the temperature rises with the current and the resistance decreases with an increase of temperature, the product of the current and the resistance must decrease with an increase of current. He gives the following complete formula:

$$V = x + y + C R$$

in which V is the voltage between the electrodes, C is the current, R the resistance, x the constant counter E. M. F. depending on the material and its temperature of volatization, and y the counter E. M. F. due to the thermo-electric effect, being a function of the material and the difference of the temperatures, the higher of which being that of volatization and the lower depending on the material and size of the electrode, the current and the length of the arc.

POWER AND HEAT.

Hydraulic Power Supply in Towns.—A paper by Mr. Ellington is reprinted in full in the Lond. "Elec. Eng.," Aug. 2 and 9, and in abstract in the Lond. "Elec.," Aug. 9. Although devoted almost entirely to hydraulic power, some comparisons are made with electric power. The working of electric substations from a hydraulic power centre is discussed, but it does not appear to offer any great advantage over the steam-driven station; in Antwerp, where the system was tried, it has not been satisfactory. He draws a comparison between the cost of hydraulic power generated at the large London station and that of the electric power generated at the Westminster station, both stations being almost exactly the same size; the figures are very nearly alike except in the cost items, in which their divergence is said to be remarkable; the costs are 1.586 cts. for the hydraulic and 2.766 cts. for the electric station per Board of Trade unit or its equivalent; he concludes that for some reason or other not hitherto explained, hydraulic power is much less costly to produce than electricity. Editorially it is stated that the difference is not sufficiently great to warrant supplying the power hydraulically; also that the load factor in the two stations is entirely different (the latter factor alone would seem sufficient to account for the discrepancy).

Cost of Water Power.—"Cassier's Mag." for August contains a brief article by Dr. Webber in which he gives the results obtained from a number of different installations. In conclusion he states that any one owning desirable water powers need not be afraid to develop them if coal costs over $2 per ton at the site; but they should be governed by the minimum reliable flow of the stream, allowance being made for what can be stored during the night; one can calculate on getting 80 per cent. net effect, or one hp for each cu. foot of water per second on an 11-foot fall. Water power is worth in any place what it will cost to replace it by steam, therefore one should find the cost of coal delivered at the boilers; one can alloy for triple compound engines 1.50 lbs. of coal of best quality per hp hour, for double compound 2 to 2.5, for single condensing 2.5 to 3, for high pressure 3 to 3.5, according to the size of the engine; to the cost of fuel add wages of engineer and fireman, cost of oil and 10.5 per cent. on the cost of the plant to cover renewals, interest, repairs, insurance, etc.

Electric Elevators.—"Cassier's Mag." for August contains a long, profusely illustrated paper by Mr. Sachs in which he gives illustrated descriptions of the leading types of electric elevators, including in some cases a number of details and the electrical connections. He believes that the electric elevator promises to supersede all its predecessors.

Heating Cars.—The "Elec. Journal" (Chicago), Aug. 1, gives the results obtained by Mr. Bowen of the Chicago City Railway Company and a summary of the replies received by him from a large number of other companies giving their experiences with electric and coal stove heating. His own test was made during the last Winter, which was rather a severe one; 76 cars were heated with hard coal stoves and 10 with two types of electric heaters; the cars are 21 feet long and were heated to 35 degrees above the outside temperature; the hard coal cost $5.35 and the stoves consumed 1.67 pounds per hour; the electric heaters consumed 6.2 amperes; the total cost per car per day of 18 hours was $0.9599 for the electric heaters, and $0.1048 for the stoves, the cost of the power or fuel in the two cases being $0.9360 and $0.0803; (it is not stated how the cost of the electric power was estimated or the power measured). The replies received from other companies scarcely admit of being summarized but they show that electric heaters averaging from 5 to 12 amperes, cost roughly about five times as much to operate and that in some cases they are satisfactory and in others they are not; the chief objection seems to be that of the cost.

Gas and Electric Heating.—The recent paper by Mr. Dowsing, abstracted in the Digest, Aug. 17, is reprinted in the "Elec. Eng. Aug. 21.

TRACTION.

Means for Preventing Electrolysis in Buried Metal Pipes.—In an article by Mr. Farnham in "Cassier's Mag." for August, he points out errors which appear to exist in the minds of some and describes a new method for minimizing the danger of electrolysis. The first error is the belief that careful bonding of the rails will prove a sufficient remedy; while good bonding is of great importance no amount of it will wholly prevent portions of the current from passing through the pipes; he cites an illustration in which an underground telephone cable was destroyed when the voltage between the pipe and the earth was only 0.5 volts. The second error lies in the suggestion of connecting the pipes with the rails at frequent intervals; this reduces the action in the district near the power station and increases it in other portions of the city; it would cause currents to leave the pipes in localities distant from the power house, returning to them again near the source of power. A third error is in the assumption that the danger exists only in large cities or where the construction is bad; he shows iron pipes destroyed in a small city where not more than six cars are run at a time; the return copper wire used in Boston is said to amount to 70 per cent. of that of the outgoing conductors, but notwithstanding this a current of 500 amperes is taken from the lead covering of telephone cables near the principal power house, which shows that good construction is not sufficient. Another error is in the belief that it is impossible to find whether corrosion is due to the current of water, or whether it is simply chemical; for practical purposes it is possible to determine with certainty whether a pipe is being electrolized by merely taking voltage measurements between the pipe and the damp earth surrounding it; when the pipe is positive to the earth, electrolysis is sure to result; the voltmeter is much better than the ammeter for this purpose. In all cities in which the single trolley system is used the earth in one section has a different electrical condition from that in other sections; he found differences reaching 50 volts or more. He then describes his method for minimizing the danger; it will also preserve the tracks from electrolytic action. The principle of his system is to preserve a balance in the electrical condition throughout the city, for if there is a balance there is no disposition for a current to flow; the method consists in extending from the negative or rail side of the dynamo an insulated return wire throughout the entire length of the railway and make it of such size as to properly carry the current, maintaining the return path at a comparatively low resistance; from this wire frequent connections are made with the track, say one at every other pole, the connections being of such a size as to keep the resistance from the rail at the nearest point to the power house, the same as that from the most distant rail connection to the power house; no ground connections are allowed on the dynamos; the rails must of course be suitably bonded; perfect results cannot be reached by this plan, but to adopt it he believes is certainly going in the right direction; it has been tried in a New England city where it shows that the benefits claimed for it may confidently be expected; it is not patented.

Storage Batteries in Power Stations.—An arrangement devised by Mr. Currie for use when accumulators are employed in power stations is described and illustrated in the "Elec. Eng.," Aug. 21. The usual practice is to connect the battery with the working circuit, but this necessitates a battery of 500 volts, which is said to increase the tendency to leakage, short-circuiting and injury to plates; the object of the present system is to obviate this and secure better regulation. A compound dynamo is connected with the main shaft of one of the regular generators; its series coil is connected to the main circuit of the main generator in such a direction that the current has a tendency to demagnetize the field; the armature of the dynamo is connected to the storage batteries; when the demand from the circuit exceeds that of the main generator the current in the series coils lowers the E. M. F. of the auxiliary dynamo so that it becomes a motor and is driven by the battery; on the other hand, when the load is light the reverse takes place and it charges the battery; it is believed that in practice the power required from the battery would not exceed 25 per cent. of the total delivered by the main generator; notwithstanding the losses involved it is thought that there are still many cases where the saving due to a steady load would more than compensate for the losses.

Starting Cars.—The "St. Ry. Rev.," Aug. 15, published a diagram giving the results of a series of tests made on a Chicago line by Mr. Knox, showing the current and loss of voltage on the line when the car is started too quickly and when it is started correctly; it shows that there is only a small gain in time made by rapid starting, while there is an enormous saving in current. The figures taken from the diagram are as follows, for the wrong and right way of starting respectively: Time until full power is turned on, 4 and 10 seconds; time at which full speed is attained, 9.5 and 12 seconds; the distance the car travels when full power is on, 13.5 and 110 feet, or when the full speed is attained, 85 and 150 feet; maximum current in making a start, 140 and 60 amperes; drop in making start, 80 and 20 volts; watt-seconds consumed in making a start, 307,176.4 and 221,676, average hp used in starting, 43.3 and 24.7; loss in hp per car, 18.6.

Cable Plant Driven by Electric Motors.—The "St. Ry. Rev.," Aug. 15, and "Elec. Jour.," Aug. 1, contain brief illustrated descriptions of the plant for driving a cable line in Chicago by a 700-hp motor, which was started July 26; the motor receives current from the power house of the electric lines. The reason for using electric motor in place of steam is that centralized power generation is cheaper than subdivided generation; the cost of fuel for the double conversion allowing 17 per cent. loss would probably be seven to eight dollars per day; the saving in labor is $28 per day; the saving in oil, repairs, and incidentals is estimated at $7 a day, so that the net saving by operating the cable motor is $28 per day.

Fenders.—According to the "Elec. Eng.," Aug. 21, the railroad commissioners of Massachusetts have issued a circular which takes effect Nov. 14, 1895, requiring that all electric cars must be equipped with

fenders and wheel guards, either with a fender at front of cars and also with wheel guards underneath, or with a fender which also serves as a wheel guard; the fender must with reasonable certainty pick up a person who is run into while standing or pass over without injury one who is lying on the ground; the wheel guards shall prevent a person who has fallen or been thrown down, from being run over.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

The "La Goule" Installation.—The "Elek. Zeit," Aug. 1, contains a long, well-illustrated description of this installation, which is said to be one of the largest of its kind and which was constructed by the Oerlikon Company during the past year; it is a single-phase alternating-current water-power installation in the Jura Mountains in Switzerland, which at present supplies 11 towns with light and power, to which six more will be added this year. An abstract of a shortened description was given in the Digest, May 11; the following additional information may be of interest. The maximum water power amounts to 4,000 hp; the single-phase system is used, but there are two entirely independent circuits, one for power and the other for light; notwithstanding the admitted advantages of polyphase currents for motor work it was decided to have only one set of machinery chiefly in order to have the units alike and interchangeable; the toothed armatures are at rest while the field revolves in a horizontal plane. In order to facilitate the starting of the single-phase motors they are provided with a fixed and a loose pulley on their shafts so that the motors may be started without any load at all; a good illustration is given of the switch and starting device; it appears that the telephone circuits connecting the stations are run on the same poles and are crossed at every tenth pole; the station is run continuously.

Statistics Concerning Provincial English Stations.—The Lond. "Elec.," Aug. 9, publishes a large table in the form of a supplement, containing data of eight municipal stations and 11 companies, giving the capital expenditure and the revenue accounts for the past year; the stations are limited to those which have been in operation for at least a year and have an output about as large as the smallest London station, that is 100,000 kw-hours. The aggregate business in London calculated on the basis of lamp connections, still exceeds that of all the provincial undertakings by 50 per cent.; the average capital expenditure of the London stations per kw-hour sold amounted to $1.22 while in the provinces it amounted to $1.08 and $1.14 for the municipal and the stock companies respectively; in London the average total cost of a unit is 7.90 cts., excluding the Deptford station, while in the provincial stations, which are summarized, it is 7 cts. for the municipal stations and 9 cts. for those owned by companies; the discrepancy between the last two is partially due to the depreciation and renewal accounts.

Three-wire Distribution from a Single Dynamo, and a Battery of Accumulators.—In "L'Elettricista" for June Mr. Sartori shows the advantages in some cases of the use of only a single dynamo in connection with a battery, feeding into a three-wire system; they are joined in series during the hours of maximum work while during the day-time the battery is charged by the dynamo being properly connected with it; the system is recommended for small installations of about 1,000 lamps, and is to be tried for the first time in a small Italian town; a diagram of the connections is given.

Monophase and Polyphase Currents.—The "Jour. Inst. Elec. Eng." for July contains abstracts of the two articles from the German by Mr. Georges, one on "A Comparison between Monophase and Polyphase Currents" and the other on "The Comparative Cost of Monophase and Polyphase Alternating-Current Systems." Both are from the same original German article which was abstracted in the Digest, Feb. 23.

Indicator of Synchronism.—The "Elec. Eng.," Aug. 21, gives an illustrated description of the Mershon (Westinghouse Company) indicator for determining when two alternators, which are to be run in parallel, are in synchronism. In the ordinary apparatus usually used it is difficult except by experience to determine the point of greatest brilliancy in the incandescent lamp; in the present instrument synchronism is indicated by a pointer moving over a dial; it consists of a coil which is connected between like electrical poles of the two alternators to be synchronized; it acts on an armature which carries a pointer moving over a scale; the armature may be either of iron or consist of a closed coil or a disc of non-magnetic material acted on inductively; if the coil is connected to the circuits so that the E. M. Fs. will be in opposition when the machines are synchronized, then as the machines approach the same speed and the E. M. Fs. approach opposition, the pointer, which at first was deflected, will move toward the zero mark; if the coil is so connected that there shall be a coincidence of E. M. Fs. on synchronism the operation of the device will be the reverse; he prefers the former arrangement.

ELECTRO-PHYSICS AND MAGNETISM.

A New Form of Ray.—In a recent paper by Dr. Wiedemann, a summary of which is published in the "Zeit. f. Electrochem.," July 20, he shows the existence of a new kind of ray which is contained in sparks and electric discharges and to which he gives the name of "discharge rays." Many substances in their natural condition show the property of emitting light when warmed; after having been heated they no longer have this property, but it returns again after cathode rays have been directed on them or after having been near electric sparks; he believes the spark acts by virtue of a special kind of ray, and this is the ray which he calls the discharge ray; he shows from experiments that the spark gives rise to such rays, and that discharges in rarefied gases also contain such rays; so far he has not been able to show that the rays are acted upon by a magnet; the form of motion, he says, must be different from that in light and the results of his experiments indicate the existence of a whirling motion; these rays are very similar to the cathode rays.

Chemical and Optical Action of Cathode Rays.—The paper by Dr. Wiedemann, which was abstracted in the Digest, July 20, is published in full in the "Zeit. f. Electrochem.," July 20.

Production of Sparks in Shunt Circuits.—In a paper by Prof. Cardain from the proceedings of an Italian academy, reprinted in "L'Elettricista" for June, he gives the results of a series of experiments intended to supplement Lodge's researches on the origin of sparks, in connection with the theory of lightning arresters; it does not admit of being abstracted.

Static and Dynamic Sparking Voltages.—An Academy paper by Mr. Swyngedauw is reprinted in "L'Elec.," Aug. 10. He states that it is generally conceded that the static and dynamic sparking voltages are equal for the same exciter; the equality of the static sparking voltages of two exciters, therefore, involves their dynamic equality whatever be the difference in the form and dimensions of the exciters. He describes experiments from the results of which he draws the following conclusion: If the explosive voltages of two different exciters are equal for the static charge they will remain equal for the dynamic charge. He gives the precautions which must be taken in obtaining these results, and among others, care must be taken to avoid ultra violet light, which lowers the dynamic explosive voltages relatively much more than the static explosive voltages.

Resistance of Bismuth to Variable Currents.—An abstract of a paper by Mr. Sodovsky from the "Jour. de Physique" for April, p. 186, appears in the "Jour. Inst. Elec. Eng." for July. He discusses the subject of the effects on bismuth of magnetic fields and variable currents, describing the experiments from which he deduces the following conclusions: "The difference observed in the resistance of bismuth with constant and alternating currents takes place out of the magnetic field with 300 oscillations per second, and can be observed in the magnetic field with even three or four oscillations per second. This difference depends on the number of oscillations per second of the current, and increases out of the magnetic field at the same rate as the number of oscillations. The resistance which bismuth, placed in an intense magnetic field, presents to an increasing current is greater, and in the case of a decreasing current smaller, than the resistance to a constant current. The difference between these two resistances increases with the rate of variation of the current, and the difference decreases when the initial strength of the current increases."

Faraday's Law with Currents of Friction Electricity.—An article by Mr. Myers with this title from the "Wied. Ann.," Vol. 55, p. 297, is abstracted with some of the data in the "Elek. Zeit.," Aug. 1. He shows experimentally that Faraday's law is true also for the so-called static electricity. He used a large Toepler influence machine with 20 discs, 30 cm in diameter, which gave a current of about 0.5 milliamperes at a speed of two revolutions per second; the current from it was passed through a silver, a copper and a water voltameter, all connected in series; from the results he determined the electrochemical equivalent and obtained a very good agreement with the usual figures.

Lines of Force.—The Lond. "Elec.," Aug. 9, contains a short mathematical paper by Mr. Rhodes in which he develops a general equation of a magnetic field caused by two point poles in air; the equation of the magnetic potential at any point in the field is considered, from which the differential equation of the equipotential surface is obtained; compared with the usual equation for equal poles in which the sum of the cosines is equated with zero, the result in this general equation is to substitute for unity a coefficient which is equal to the ratio of the pole strengths, as the coefficient of the cosine of the angle at the stronger pole.

Effects of Electric Currents in Iron on Its Magnetization.—The paper of Dr. Hopkinson, which was abstracted in the Digest, May 25, is being reprinted in full with illustrations in the Lond. "Elec. Rev.," beginning with the issue of Aug. 9.

The Earth a Magnetic Shell.—The "Am. Jour. of Sc." for August contains a long article by Mr. Bigelow in which he gives the vectors of the polar-magnetic field at the earth together with certain deductions suggested by them. In conclusion he shows the importance of fully determining the magnetic action of the sun on the earth suggesting that such measurements would become valuable for forecasting weather and allied phenomena.

Distribution and the Secular Variation of Terrestrial Magnetism.—The first of a series of articles by Dr. Bauer on this subject is published in the "Am. Jour. of Sc." for August.

Velocity of Electric Waves.—The article by Profs. Trowbridge and Duane, which was abstracted in the Digest, Aug. 24, is published in part in the "Am. Jour. of Sc." for August.

ELECTROCHEMISTRY AND BATTERIES.

Efficiency of Electrolytic Apparatus.—The Lond. "Elec.," Aug. 9, abstracts a recent paper on this subject by Dr. Hurter. He points out that the commercial value of a process depends on the cost of producing

the energy, the efficiency of the electrolytic apparatus, the cost of the apparatus, the cost of maintaining it, the length of its life and the amount of manual labor required; it is therefore very difficult to judge between different processes. He has made special investigations with what he calls the "current efficiency" the results of which he will publish later; if the products could be removed instantly the exact electrochemical equivalent could always be obtained, but this cannot be accomplished, although the Castner cell is an approach to it; as calculations regarding polarization never produce certain results, it is best to make measurements, for which purpose he prefers the following method: the current is passed through a long trough, between the two electrodes, between which another very small one is inserted which is connected with the anode through a voltmeter of 100 ohms resistance and then in the same way with the cathode; the voltage between the terminals of the cell is also measured; if the latter is t and if a is the voltage between the auxiliary electrode and the anode and c the corresponding one with the cathode then the E. M. F. of polarization will be $t-(a+c)$. For making measurements on a large scale he suggests measuring the E. M. F. immediately after opening the circuit, after the normal current has passed through for some time, but the value obtained is usually too small; another method is to pass currents of very different magnitudes successively through the cell and measure the voltages at the terminals, from which that due to polarization is easily calculated. Tabulated details giving the results of experiments with carbon anodes are given in the original but not in the abstract; those of highest conductivity are most liable to disintegration; after having undergone a special heating by a powerful current or in an electric furnace it resists disintegration better and the conductivity is improved; diaphragms constitute a considerable, if not the greatest, part of the total resistance; wooden diaphragms have a very high resistance, a sheet 0.006 in. has the same resistance as a Portland cement diaphragm 0.375 in. thick.

"L'Elec.," Aug. 3, contains an abstract of the same paper by Mr. Andreoli, with some additional information.

Effect of a Perforated Septum in an Electrolyte.—In a short article in the Lond. "Elec. Rev.," Aug. 9, Mr. Fitzgerald discusses the effect of a perforated septum of insulating material in the electrolytic path of a circuit, showing that it is erroneous to believe, as is often done, that if a sheet of insulating material is placed in the path of an electric current through an electrolyte, and if say one half of the insulating material is removed by perforation, there will still be twice the resistance which will be opposed to the passage of the current if the sheet is removed altogether; he shows that it is the resistance of one layer only, out of many, that is doubled by the introduction of the perforated sheet; (this is not quite correct either, but is a much closer approximation than the previous statement.) He believes it to be an indispensable necessity in accumulators used for electric traction, to use with the acid an absorbent which is itself an electrolyte, so as to render the accumulator "dry"; the main difficulty in doing this is to render the absorbent sufficiently conductive but this difficulty he believes has now been overcome; (see abstract below.)

A Low-Resistance Dry Accumulator.—In the Lond. "Elec. Rev.," Aug. 9, Mr. Fitzgerald gives the results of a number of tests made with an accumulator using his "Absorbed Electrolyte"; in the introduction he states that impeded circulation is one of the main difficulties to be encountered in dry cells, and calls particular attention to the fact that in the results of the tests the E. M. F. recovers very quickly during a short rest. The experiments were made with E. P. S. accumulators, one of which, A, was used as sent out, and in the other, B, the acid was replaced by an absorbent, saturated with the electrolyte and having the appearance of a nearly dry cake; cell A weighed 24 lbs. 13 oz., while the other weighed 26 lbs. 2 oz.; the maximum rate of discharge of A, allowed by the makers, was 13 amperes. In the tests the two cells were charged and discharged in series at different rates, some of them greatly exceeding the maximum allowed by the makers; the general results are that on charging, the voltage of the dry accumulator was slightly greater, and on discharging slightly less, but after a period of rest during the discharge, the E. M. F. of the dry cell was higher or nearly as high; the discharges were all made with periods of rest; the greatest discharges were made with 22 to 32 amperes or about double the maximum allowed by the makers. At the end of a number of discharges some of the active material on the positive plates of the A cell had become detached and parts of the plates showed signs of disintegration; it was said to be evident that that cell would soon be destroyed if worked at such high rates; cell B was not examined as "the plates were so tightly packed in the absorbent material that it becomes difficult to imagine how disintegration can take place."

Accumulator.—In a paper by Dr. von Kowalski reprinted in the "Zeit. f. Electrochem.," July 20, he describes his new accumulator. It consists of a perforated envelope of celluloid in which is placed an electrode of lead and antimony; the space between the two contains paper pulp and pulverized oxids of antimony and lead; these are placed in an electrolyte whose composition is kept a secret; the liquid is absorbed by the powder, and, after the electrode has been immersed for a day, it is dried and is then a compact mass; by repeated formations with a current of three amperes a capacity of 20 amperes per kg of plate is obtained, which is increased to 25 and 57 after eight days of forming. It is used on 50 cars on the French railroad for lighting purposes; he claims that 860 kg of this accumulator will suffice to do the work of the 1,700 kg of batteries at present in use for traction in Paris; a test showed a capacity of about 18 ampere-hours per kg. (The description is not as clear as might be desired.)

Fuming Sulphuric Acid.—Mr. Hill, in the Lond. "Elec. Eng.," Aug. 9, states that about five years ago a German chemist produced the fuming acid from sulphuric acid by passing an electric current through the sulphuric monohydrate between two carbon plates about one eighth inch apart; the water of the acid is decomposed, but the other elements are absorbed by the electrolyte forming the fuming acid; as soon as a layer of sulphur is observed on the electrodes the current is reversed; as far as he knows, this has never been tried on a commercial scale.

Electric Tanning.—In a paper by Dr. Foelsing, reprinted in "Zeit. f. Electrochem.," July 20, after describing briefly the Worms and Bale and the Groth systems, he gives a description of a method of his own. By means of the other systems he states that it is either difficult or not at all possible to treat thick leather; in the present system light and heavy kinds of leather may be prepared in three to six days; the apparatus consists of a basin in which the hides are hung and through which the liquor is made to circulate; the tank has a capacity of 15,000 litres: the electrodes consist of plates of copper which have been nickel-plated, and they are placed at the ends of the tank so that the current must pass normally through the hides; the current is a continuous one. He obtained the following results: Light leathers require 72 hours and heavy ones five and six days; the color was not good when unclarified extract was used, but was very satisfactory when oak extract was used with a small addition of hemlock extract; the current required was 12 amperes at 60 volts; an analysis showed that the leather thus tanned could not be distinguished in its composition from that tanned by the old method. He suggests that the hides, during this process, act like intermittent electrodes. In the discussion Dr. Borchers stated that until now he had only heard of negative results in the application of electricity to tanning; in a very short time the E. M. F. required became so high that the cost of power became far too great.

Production of Ferments with the Aid of the Electric Current.—According to a note in the "Electrochem. Zeit." for August Mr. Moller found that by the action of the electric current on liquids containing different micro-organisms, only certain species remain alive, and in this way one cannot only obtain ferments, like yeast, free from impurities, but one is enabled by the application of the same current to keep the desired kind of ferment from degenerating; an application in the manufacture of sugar is briefly described.

Electrolysis of Fused Salts.—The serial of Mr. Andreoli is continued in "L'Elec.," July 27; he continues his critical historical summary.

New Developments in the Electrolytic Alkali Industry.—In a series of articles by Dr. Weyer begun in the "Electrochem. Zeit." for August he gives an illustrated summary of those recent improvements in this field to which is due the recent progress; the present portion is devoted to diaphragms. In introducing the subject he remarks that the difficulties regarding diaphragms and electrodes which at first proved to be serious drawbacks, have now been overcome.

Electrochemistry.—In the "Rev. Gen. des. Sc.," July 15, Mr. Urbain gives a brief summary of the recent progress in this field and the present industrial applications.

Dissociation Values.—The "Tech. Quart." for April contains a paper by Messrs. Noyes and Abbott on "A Comparison of the Dissociation Values Calculated from Solubility Experiments and from the Electrical Conductivity." The paper treats of an experimental verification of the principle first expressed by Nernst, that "the product of the masses of the ions of the salt with which the solution is saturated remains constant in the presence of other salts." Their results may be summarized as follows: with three salts having solubilities varying from 0.022 to 0.028 normal, it has been proved, first, that the two principles of solubility effect are valid; and, second, that the values of dissociation obtained through the electrical conductivity agree with those calculated from solubility measurements; they show conclusively that the law of mass action cannot be applied to determine the change of dissociation with the dilution; the law applied to the dissociation of salts must be modified as follows: the product of the concentrations of the ions at different concentrations of the solution is not in a constant ratio to the concentration of the undissociated salt; but, corresponding to any given concentration of undissociated salt, the product of the concentrations of the ions has a constant value which is altogether independent of the relative concentrations of the separate ions.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Daily Insulation Testing of Telegraph Lines.—The "Jour. Inst. Elec. Eng." for July contains a short paper by Mr. Preece in which he describes the method of Mr. Eden for determining the insulation resistance of wires each morning. At a certain time the minor testing office loops the wires in pairs for a certain number of minutes; the test is made in sections of an average length of 50 miles; a differential tangent galvanometer and a carefully estimated E. M. F. of a little over 55.5 volts is used at the principal office; the positive pole of the testing battery is put to earth and a current is sent from the negative pole through one of the

galvanometer coils and a resistance of 10,000 ohms, thence to the loop wire, a second resistance of 10,000 ohms, and the other coil of the galvanometer, to earth; as the current sent out and that received pass through the galvanometer in opposite directions it follows that if the insulation is infinite the galvanometer will read zero while any difference between the two currents will give the exact amount of the leakage, the mean value of which is found by reference to tables. Some modifications and other tests are briefly described.

Tests of Dry Cells.—The results of a series of extended tests are given in the form of curves in an article by Dr. Epstein in "Zeit f. Electrochem.," July 20. Cells of two different types and of different sizes were tested under conditions approaching as nearly as possible those under which they are to be used in practice; they were discharged during five minutes with 50 milliamperes and were then given a rest of five minutes; on Sundays they were given a rest of 36 hours; the records were kept by means of recording instruments operated by means of a clock; the general outline of the curves resembles somewhat that for accumulator discharges. During the first week there is only a lowering of the voltage, although during the discharge it was constant; after the tenth week there was a fall in the voltage during the discharge.

The Potentiometer and Its Uses.—An article by Mr. Crapper is begun in the Lond "Elec. Eng.," Aug. 9; he gives a good easily understood description of the principle of the potentiometer and of the methods of using it; it appears to contain nothing new but seems to be a good summary of the subject.

Magnetic Tester for Measuring Hysteresis in Sheet Iron.—Prof. Ewing's Institution paper (see Digest, May 18 and 25), is published in full with the discussions and illustrations in the "Jour. Inst. Elec. Eng." for July.

Factory Testing of Rubber-Covered Cables.—A serial by Mr. Warren on this subject is begun in Lond. "El'ty.," July 26; it is written in an easily understood style.

Three-phase Condensers.—A device suggested by Mr. Bradley is briefly described and illustrated in the "Elec. Rev.," Aug. 21. He found that the plates of a condenser may be connected in regular succession with the three or more mains of a polyphase system and the action will then be analogous to that of the several phases in a rotary magnetic field, except that the action will be electrostatic instead of electromagnetic; the advantages in using such a condenser with polyphase motors, is that it prevents the lag or so-called false currents; the single condenser does the same work as three independent condensers do in present practice and the total number of plates needed is much less, reducing the amount of material to about one half.

Galvanometer for Photographing Alternating-Current Curves.—The "Phys. Rev." for July-August contains an illustrated article by Messrs. Hotchkiss and Millis in which they describe the construction and application of a galvanometer which was used by them very successfully and which could be depended upon; it is essentially a galvanometer with a very small soft iron needle, a very strong directing field and a single small coil carrying the current which deflects the needle; the number of double vibrations of the needle was 3,500 while the frequency of the currents experimented with was 120 and it was not possible to detect the slightest distortion of the curve due to the natural period of the needle.

TELEGRAPHY, TELEPHONY AND SIGNALS.

An Electric Telegraph in the Middle of the Last Century.—Mr. Gibson in Lond. "El'ty," July 12, states that the late Sir David Brewster found in a copy of "Scott's Magazine" of Feb. 1, 1753, a full description of a practical means of sending messages by electricity; the article is signed C. M., which is believed to stand for Chas. Morrison; it is said to be the earliest definite record of such an invention. In the present article the description is given as follows: "Twenty-six wires were stretched horizontally between the two places from which the messages were to be sent and received, the wires being supported on insulators at short distances apart. The wires were then fixed in a piece of solid glass, at about six inches from their extremities, and these six-inch ends were stiffened so that if depressed they had sufficient spring to return to their horizontal position. About one inch below these was placed the 'electric gun barrel' and from each of the horizontal wires was suspended a short wire with a metal ball at its extremity, there being, therefore, 26 balls. Immediately under each ball was placed a small piece of paper bearing one letter of the alphabet upon it, the distance between the papers and balls being about one eighth part of an inch. To signal the letter A, the operator, having set the electrical machine in motion, would take a piece of glass in his hand and touch the spring piece of the first wire, thus depressing it so that it would come in contact with the 'electric gun barrel.' The two metal balls, one at either end of the first wire, would then become charged and would therefore attract the small pieces of paper lying below them, so that the person at the distant station would take note of the letter A, while the operator would also see from the movement or non-movement of the paper at his end, whether the wire had been sufficiently charged or not. In the same way all the other letters of the alphabet could be signalled in any desired order, thus enabling intelligible messages to be transmitted." To get over the difficulty regarding insulation the original writer suggests covering the wires with a thin coating of jeweler's cement which being "an electric per se, will secure any part of the fire from mixing with the atmosphere"; the original writer did not sign his name as he thought he would probably be ridiculed.

Automatic Railway Signal System.—A well-illustrated description of the Hall system, which is used largely in this country, is published in Lond. "Engineering," Aug. 9.

Automatic Telephone System.—An illustrated description of the Nissl system, which has been referred to several times in these columns, is begun in the "Jour. Teleg." for July.

Sending Pictures by Telegraph.—A system devised by Mr. Lowd is described and illustrated in the "Elec. Rev.," Aug. 21. The drawing is made on cross-section paper having 476 blocks about one fourth of an inch square each divided into nine smaller blocks numbering from one to nine; the large blocks are designated by marginal letters or words as used on atlases and plans; the design is drawn in broken lines and the locations of the points are telegraphed according the above system; an illustration is given.

MISCELLANEOUS.

Alloys.—A portion of a long article on alloys by Mr. Le Chatelier, published in the "Rev. Gen. des Sc." June 30, is devoted to the electric conductivity of alloys and includes some interesting curves showing the conductivity of the alloys of pairs of metals of all different compositions, some of which curves show a decided angular maximum point for certain proportions; one of these is shown to exist for an alloy of antimony and copper, another for tin and copper, another for silver and copper and another for tin and gold; another of other curves show that there is no such maximum point; among them are silver and gold, gold and copper, lead and bismuth, lead and antimony, tin and bismuth and tin and antimony; the curves are straight, sloping lines for an alloy of zinc with cadmium of tin, cadmium with tin or lead and tin with lead; these maximum points indicate the existence of definite chemical combinations; the E. M. F. of dissolution of the alloys gives more precise indications of the existence of these combinations; if the metals are simply mixed without combining, the observed E. M. F. is for all the compositions that of the most easily attacked metal; if a definite combination is formed the E. M. F. of the most easily attacked metal is observed only for proportions of this metal greater than those which correspond with the definite combination; at the definite combination there is a sudden change in the value of the E. M. F.; a curve showing this is given. The thermoelectric power varies considerably with the composition but no definite relation has yet been found to exist between that variation and the chemical constitution. Curves are also given for iron, nickel and two combinations of these metals, showing the resistance at different temperatures.

Lightning.—A German meteorological journal, in giving some statistics regarding Berlin showing the increasing damage done by lightning, attributes the cause of the increase to the following: use of electricity in the industries, modifications of the surface of the earth due to the cutting down of forests, drainage, impurities in the atmosphere due to the increasing consumption of coal, etc. Prof. Bezold states that persons struck by lightning do not hear the thunder nor see the lightning, but have the impression of having been suddenly surrounded by fire.

Electric Organs.—The long, well-illustrated serial by Mr. Lefevre in "L'Elec." is concluded in the issue of Aug. 3.

Artificial Rubber.—An abstract in the "Jour. Frank. Inst." for August states that a rubber of more or less strength may be made by dissolving four parts of nitro-cellulose in seven parts of bromo-nitro-toluol; the proportion of the former may be varied, making a material resembling india rubber or gutta percha; nitro-cumol may be used instead of the second constituent.

Artificial Respiration.—A long article by Dr. Bleyer describing his new method of artificial respiration is begun in the "Elec. Rev.," Aug. 21. He calls it a pneumatic artificial method founded on establishing rhythmic breathing by means of tubing the glottis, connecting the tube with an air tank and allowing the exhaled gases to flow off by a special valvular opening; the air is forced in at graded pressures controlled by a special controller; some of the parts are illustrated.

Cataphoresis.—The paper of Dr. Morton, mentioned in the Digest last week, is reprinted with the illustrations in "El'ty.," Aug. 21.

Biographical.—A large and very good portrait of Prof. Elihu Thomson is published in the "Elec. Jour." (Chicago), July 15, and one of Joseph Henry in the issue of Aug. 1.

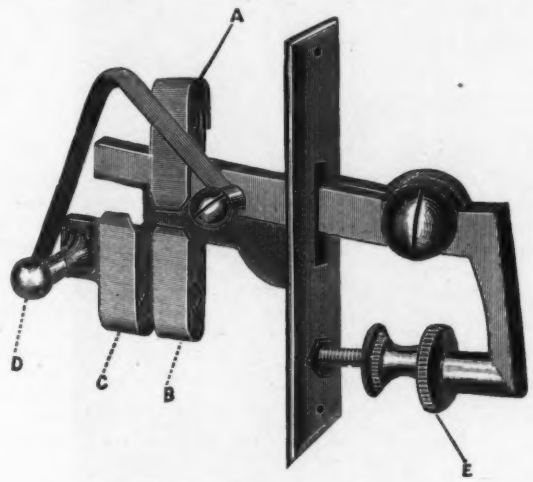
Cost of Installation in Switzerland.

Mr. C. E. L. Brown gives the cost per horsepower of a Swiss water-power installation as follows: Turbines and water power, $160 to $200; generating plant complete, $20; line, $10 to $20. The average cost is given at $220 per horsepower complete.

A Non-Infringing Telephone Switch.

The accompanying illustration shows a universal telephone switch manufactured by E. C. Bradley & Co., of Rochester, N. Y., which the makers claim to be non-infringing in construction and reliable in operation. The cut is self-explanatory; the extension arm is provided with a pin projection which enters the screw-eye with which all telephone receivers are provided. Moving the arm over to the right releases the reeeiver and performs the necessary switching at the other end of the lever within the box; the cut shows the lever in this position.

The switch is compact, substantially made and neat in appearance, and the manufacturers claim that over 20,000 are in use and giving entire



UNIVERSAL TELEPHONE SWITCH.

satisfaction. The device can be adapted to serve as either a fixed support and hand switch, or a semi-automatic switch; in the former case the receiver may be hung in place or removed irrespective of the switch, while in the latter, the proper connections must be established before the telephone can be removed.

A Long-Distance Transmission Project.

A unique long-distance power transmission plant is in course of construction at Fresno, Cal. The head of water to be used is 1,410 feet and the distance of transmission about 35 miles. The natural conditions surrounding the installation are extraordinary in themselves. The water for supplying the power will be taken from the North Fork of the San Joaquin River where the two streams join. The North Fork runs for several miles down a rocky canyon, forming rapids and cataracts as it rushes between the steep mountains. At the head of the rapids a canal will lead the water off upon the summit of a high ridge, which it will follow for six miles to a point nearly fifteen hundred feet above the San Joaquin River. Here a reservoir has been constructed with an average depth of 10 feet, covering about eight acres, which can, however, be made both larger and deeper should the demand for power require an extension. Into this reservoir water will be stored from the canal solely as an emergency supply. It is calculated that the reservoir will hold enough water to drive the machinery for several days, so that in case a break should occur in the canal between the reservoir and the source of supply, the electrical work could continue until the repair was effected, unless the period covered by repairs should prove excessive. A pipe line runs from the canal a distance of about 4,000 feet to the power house, and the head of water there will not be less than 1,410 feet. The lower end of the pipe line is of welded steel, three quarters of an inch thick, having special steel flanges and special packing at the joints. The lowest amount of water power available is calculated to be at least 7,000 hp at the head above mentioned. An air valve will be provided near the upper end of the pipe to relieve the pressure which would result should a break occur near the lower end and a vacuum be formed in the upper portion of the pipe by the rush of water out below. The pipes will be made in sections of 20 feet each; at the upper end the metal will be one quarter inch thick and the pipe 24 inches in diameter. It will be fastened to the solid granite mountain sides by steel cables.

The power station will be located at the bottom of the mountain, and will contain three Pelton water wheels 58 inches in diameter, driven by a single nozzle. The generating plant will consist of three 340-kw General Electric three-phase generators.

From the point in the North Fork where the water is led off to the power house at the foot of the mountain is a distance of about seven miles. From the power house in Fresno, where the electricity will be utilized, is about 31½ miles in a direct line, or 35 miles the way the wires will run. The line will consist of two circuits of bare copper wire, consisting of six wires strung on poles 40 feet high. The current will be delivered to the lines at 11,000 volts. From the power house the line will rise to the level of the San Joaquin, cross it and pass through a portion of the Auberry valley, then rising over the Red Mountain, and passing about a mile west of Clovis, it will continue direct on to Fresno. The first five miles will be over moderately level country, the other 30 through an open and practically level country under ideal conditions for line construction. It is estimated that the power which will be delivered in Fresno at the beginning will not be less than 900 hp.

At Fresno the line will be brought into a sub-station where current will be transformed down. From the sub-station current will be delivered to the water works, machine shops, planing mills, etc., and power will be furnished to drive the street railway system of the city which will require about 300 hp. In the sub-station, two arc light dynamos, each of 60 lamps capacity, will be driven by an induction motor, the motor being mounted on the same bed-plate and direct-connected to the dynamos. Current will be supplied for 4,400 incandescent lamps from the secondary mains.

Three-Phase Transmission at Silver Lake, Col.

Another interesting application of the three-phase system to the long-distance transmission of power has recently been made by the General Electric Company. The plant is located near Silverton, Col., where power is transmitted a distance of three miles through some of the roughest country in Colorado, to the Silver Lake Mines, and it is the first one of its kind to be established in the Rocky Mountain region.

The Silver Lake group of mines owned by Edward G. Stoiber, lies about four miles southeast of Silverton, and is situated at an altitude of 12,300 feet above sea level. The ore mined carries both gold and silver, is of a comparatively low grade and requires concentration. Previous to the adoption of electricity, the mill, which is situated on the shores of the lake, near the mouth of the mine tunnel, was run by steam. Coal was brought to the boiler house by a zig-zig path up the mountain, shown in Fig. 1, and by the time it reached the furnace cost $8.75 a ton. The plant is now operated by water power which is brought from the Animas River, above Silverton, through a 3 x 4 foot flume 9,750 feet in length, capable of discharging 2,350 cubic feet of water per minute. The flume and trestle are shown in Fig. 2. It is worthy of note that it was found less expensive to build this costly two-mile flume, running from above Silverton down to a spot where the necessary head could be utilized, and then to transmit the electricity back to the mine, than to continue to burn coal at the price which it brought at the mouth of the Silver Lake mines.

The head of water obtained is about 180 feet; this develops on the water-wheel shaft 640 hp. The generating plant consists of two four-foot double-nozzle Belton water wheels, with special buckets, and two 150-kw three-phase generators, driven by belts from the water wheels. The

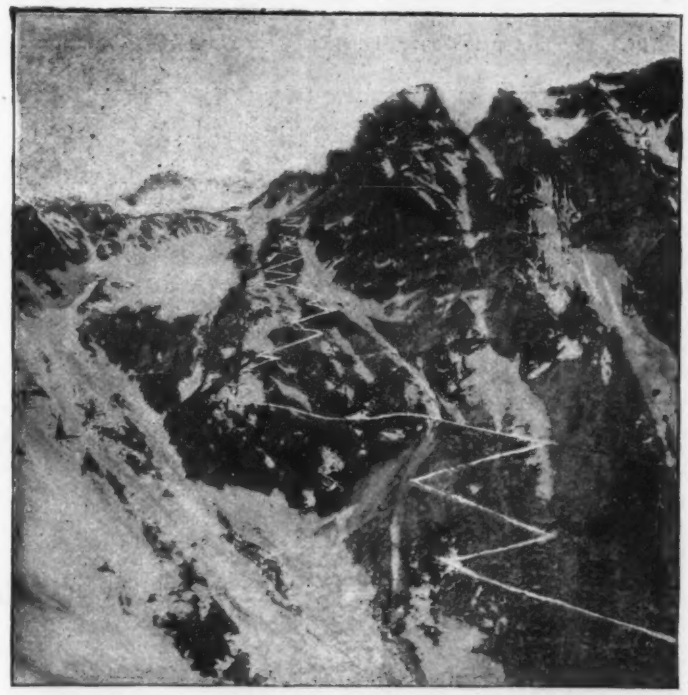


FIG. 1.—VIEW OF PATH UP TO THE MINES.

energy from these machines is transmitted at 2,500 volts E. M. F. over a distance of a little more than three miles to the Silver Lake mill and mine. The conductors are No. 3 B. & S. bare copper wires, one for each leg of the three-phase circuit. These are strung from the power house, shown in Fig. 3, up the mountain passes and through the rugged country shown in the illustrations. In one place a chasm has to be spanned 275 feet in width. The line has been constructed with special regard to the abnormal conditions. At each insulator the wire is run through a short piece of rubber tube as an extra precaution against leakage. Lightning arresters are placed at each end of the line, and an additional safeguard against possible damage by lightning is provided in the shape of a barbed

iron wire which extends the entire distance of the line along the tops of the poles and is grounded at every second pole.

At the mine a 100-hp three-phase induction motor receives current directly from the primary circuit. Another 100-hp motor and one of 75 hp are located in the mine, and current is supplied to these at a pressure from eddy currents are largely eliminated. The speed of the motor is at all loads practically constant. The starting resistance for preventing any excessive current in the armature winding while gaining speed is contained in the armature itself and the handle shown in the cut serves to cut out the resistance when the motor is fully up to speed.

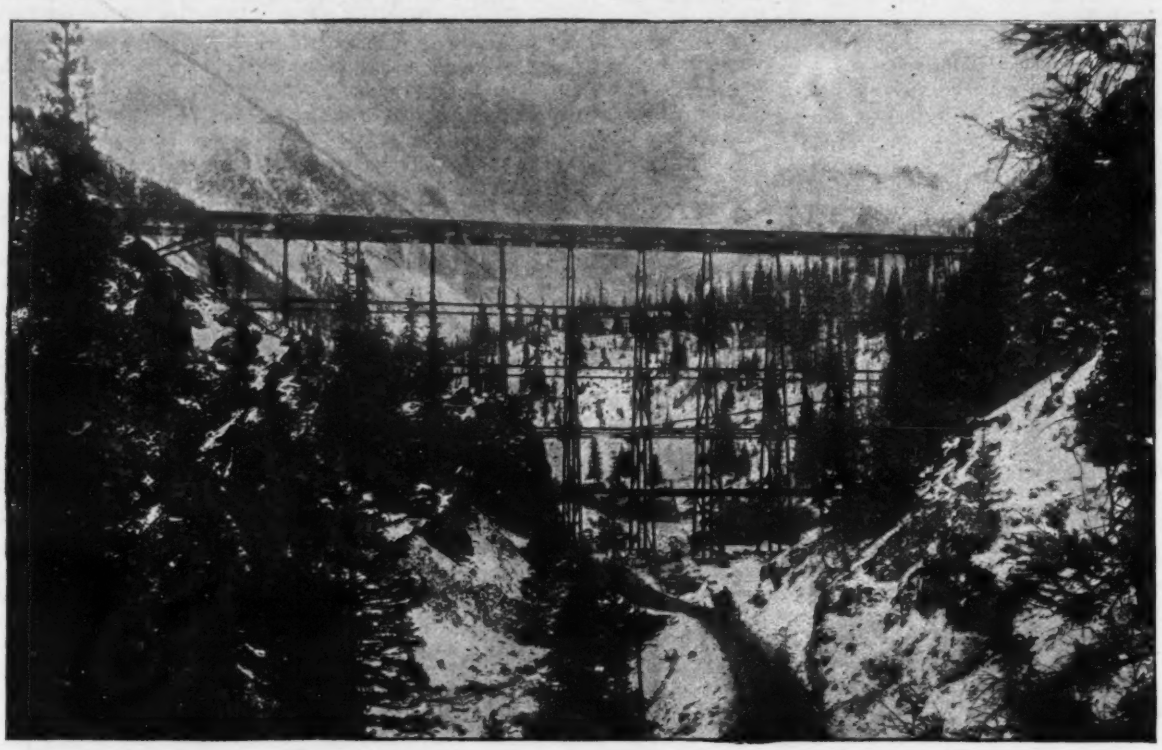


Fig. 2.—Trestle Across the Gorge.

of 220 volts, the reduction in voltage being effected by step-down transformers. Besides these, a 15-hp motor drives a pump for raising water from the lake to the mill, and a 1-hp motor operates a blower, and lights for a bunk, office and other buildings are fed from the secondaries.

The induction motor used (see Fig. 4) is an excellent representation of the latest type of alternating-current motor built by the General Electric Company. There are no commutators, collector rings or brushes; the field winding is connected to the circuit, but there is, of course, no connection between the armature and any external source of current.

The field and armature cores are so completely laminated that losses

The interest in this mine centres, of course, upon the economy induced by the electrical installation. The power used in the mill and the mines at the present time is more than three times as much as was furnished by the steam engine previously employed, and, therefore, an economy of about $36,000 gross a year is effected by the operation of the mine by electricity, and a greater power is available. From this, of course, must be deducted the interest on the investment and the depreciation of the plant. A most decided additional advantage, however, is obtained by the substitution of electricity for steam, namely, the operation of machinery inside the mine, which was impracticable before.

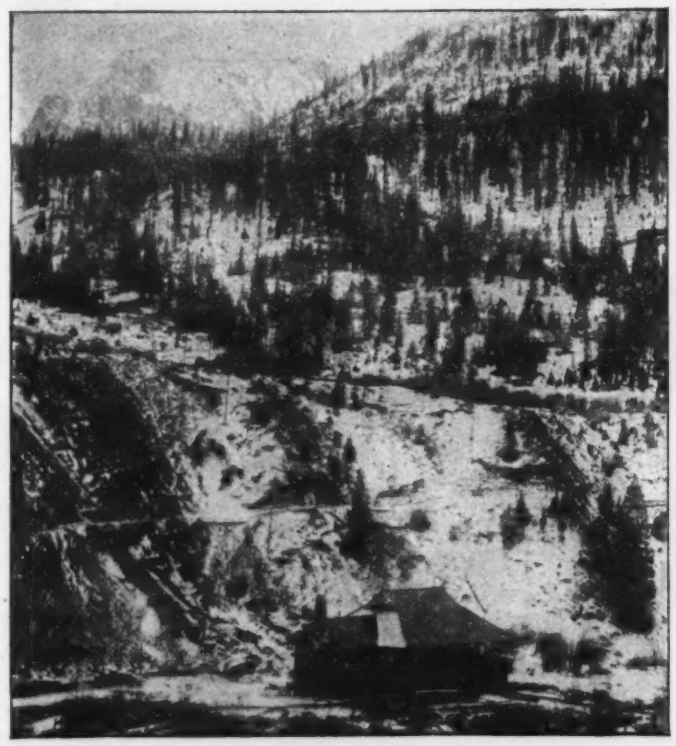


Fig. 3.—Power House on the River Bank.

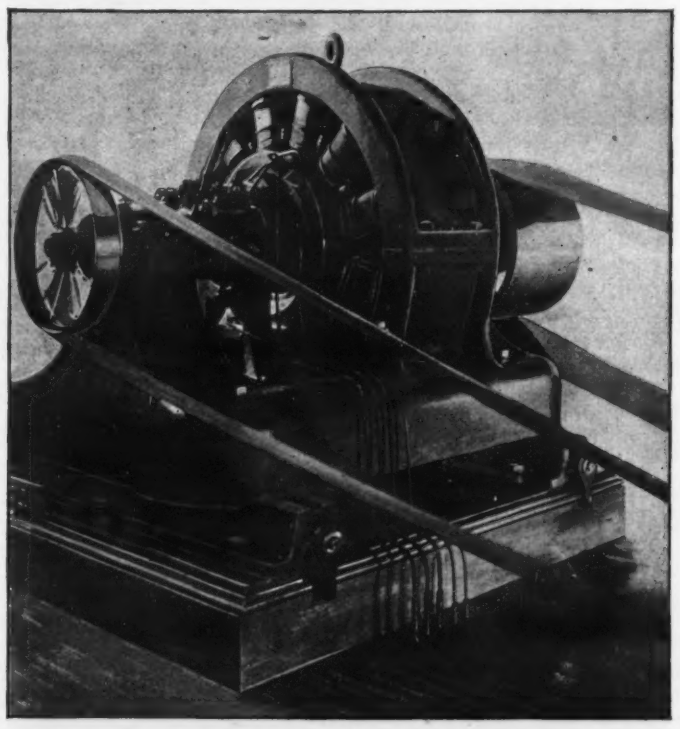


Fig. 4.—One of the Induction Motors.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Aug. 24, 1895.

AMERICAN BELL failed this week to maintain the firm aspect displayed steadily for the past two weeks. Opening at last Saturday's closing, it immediately reacted to 198, and continued declining until it reached 195 on Wednesday. A rally to 198 followed on Thursday, and the stock hung at that point the balance of the week. It is evident that concerted efforts to bull the stock have been made by Bell advocates all through the Summer, and more particularly since the reversal of Judge Carpenter's decision in the Berliner case.

ELECTRIC STORAGE BATTERY continues strong and active; on Thursday the stock reached its highest point this year, selling up to 46. Later on, however, selling to realize profits, by those who had previously picked up some of the stock at low figures, caused a reaction to 45. The stock appears to have come into marked favor on the Philadelphia exchange for both speculative and investment purposes, probably owing to the rather advantageous position of the company as regards volume of business and control of patents.

BALTIMORE TRACTION was slightly weakened recently by continued offerings until it was ascertained that these were due to the settling up of an estate. The stock braced up at once, and has continued firm between 20 and 21 ever since, occasionally taking a spurt over the higher figure.

PEOPLE'S TRACTION stock has been steadily absorbed for several weeks past by good houses, and as a consequence has shown a climbing tendency. On Wednesday the stock reached 68, which is the highest price it has ever brought.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	98	100
" " " Brooklyn	100	110	115
" " " Boston	100	150	..
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	45	45¼
General Electric	100	36⅝	36¾
General Electric, pref	100	69	71
Westinghouse Consolidated, com	50	36½	36⅞
" " pref	50	53	54

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	..	198
American District Telegraph	100	30	40
American Telegraph & Cable	100	96	100
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	54	54½
Gold & Stock Telegraph	100	105	..
New England Telephone	100	88	90
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	..
Western Union Telegraph	100	94	..

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	20	20¼
Binghamton RR. com	100	100	..
Brooklyn Traction	100	15	18½
" " pref	100	..	53
Buffalo St. Ry	100	88	91
Cleveland City Ry	100	69	70
Cleveland Electric Ry	100	59	60
Columbus St. Ry	100	48½	..
Consolidated Traction of N. J	..	25	27
Electric Traction, Philadelphia	50	74⅞	75⅛
Hestonville	100	59	59¼
Long Island Traction, 1st in pd	100	15	15½
Louisville St. Ry. com	100	37	39
" " " pref	100	87	88
New Orleans Traction	100	24	27
" " pref	100	79	81
North Shore Traction	100	34½	36
" " pref	100	84	88
People's Traction $30 pd	25	68	68⅛
Philadelphia Traction	50	84½	84¾
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	76¼	76½
" " pref	100	92	92½
Worcester Traction	100	18	20
" " pref	100	86	90

BONDS.

Buffalo St. Ry. 1st con. 5s	100	106	109
*Binghamton Railway Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	104	..
Rochester St. Ry. 1st 5s	100	95	97
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.
† Ex-Div.

UNION TRACTION COMPANY did not take out its charter on Monday, and the reason given is that the cost of obtaining a $30,000,000 charter is $75,000 and therefore the company's counsel determined to withdraw the present application and file a substitute placing the capital stock at $15,000,000, which is to be subsequently increased as desired.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Aug. 26, 1895.

IMPORTANT IF TRUE.—The report is being circulated that the Metropolitan Street Railway Company is contemplating the adoption of electricity on its lines.

ELECTRICAL WORKS UNION NO. 67 has elected Wm. H. O'Neil, of Union Hill, N. J., president. The new recording secretary is Patrick Murrin and M. Mescall has been elected financial secretary.

FREDERICK NOLL, recently of the firm of Noll & Sibley, has accepted a position with the Interior Conduit & Insulation Company. Mr. Noll will have charge of the company's sales department for New York and vicinity.

HARRY OSBURN, president of the Osburn Electric Supply Company, Chicago, who has been East on a visit to different factories for the purpose of placing Fall orders, left New York Wednesday last on his return trip.

FROM STEAM TO ELECTRICITY.—The Lutheran steam line of the Brooklyn Heights Railway Company, running between Ridgewood and Lutheran cemetery, has been changed to an electric line, and hereafter cars will run more frequently, giving better service to the public.

M. B. AUSTIN, Chicago agent for the Safety Insulated Wire & Cable Company and Holmes, Booth & Haydens, is spending a few days in the East, combining business with pleasure. Mr. Austin reports a large number of orders received from Western firms and does not think it safe for him to return to Chicago until his factories have at least made partial shipments on them.

EARNINGS OF THE NASSAU COMPANY OF BROOKLYN.—It is stated that the Nassau Electric Railway of Brooklyn has gained each week it has been in operation in the number of passengers carried. On Aug. 11 the receipts were $2,900 and it was impossible for the road to carry the people who wanted to ride. The average receipts during the week ending Aug. 18 were about $1,700 a day.

BROOKLYN, N. Y.—A certificate has been filed with the Secretary of State by the Coney Island & Brooklyn Railway Company, setting forth that in consideration of the sum of $10,000, received from the City of Brooklyn, the company surrenders and abandons its franchise and right to lay tracks and maintain and operate a railway on Fort Hamilton Avenue and on the Ocean Parkway, from Fort Hamilton Avenue to the southwestern circle of Prospect Park.

TELEPHONE COMPETITION.—The Elizabeth (N. J.) Telephone Company the new rival of the New York & New Jersey Telephone Company, has been granted a franchise by the City Council of Elizabeth. The ordinance fixing the routes and making the other provisions of the franchise was identical with the former ordinance which gave the franchise to the Elizabeth Mutual Telephone Company, enjoined in the construction of its lines by an injunction obtained by the New York & New Jersey Telephone Company.

TROLLEY SERVICE UNDER DIFFICULTIES.—The Union Trolley Company is having some trouble with its new line in the Southern Boulevard. The company has recently laid a double track along the Boulevard and at 143d Street, where a branch track of the New York Central crosses, the railway employees declared a blockade against the trolley line. On Monday last, however, the workmen on the trolley line managed to get the rails laid across 143d Street, but when they attempted, on Tuesday, to run a car across the railway tracks, they found an engine and three cars on the crossing. The engineer refused to move his train and the trolley car passengers were compelled to transfer to another car on the other side of the crossing.

CAR-SPEED INDICATOR TEST.—Chief Trolley Inspector Charles F. Franklin has reported to Mayor Schieren, of Brooklyn, the result of a new speed indicator made on car No. 134, of the Brooklyn City & Newtown Railway Company. Mr. Franklin speaks of the indicator in the highest terms. When the speed of the car reached eight miles an hour a bell indicated the fact. When a speed of ten miles an hour was reached the regulator cut off the electric current from the motor, thus preventing an excess of speed of ten miles. The device consists of a centrifugal ball-governor arrangement driven from the axle of the car and adapted to actuate a pointer on the indicator dial in the car. The mechanism is also arranged to close the circuit of an alarm bell when the car reaches a speed of eight miles, and at ten miles an hour the governor throws a trip in the controller which releases the controller from its handle and allows the drum to be returned to the zero point by a retractile spring.

BROOKLYN SURFACE ROADS AT THE BRIDGE.—President Howell, of the Brooklyn Bridge trustees, has sent to Comptroller Palmer, chairman of

the committee on surface railway connection with the new Brooklyn station, a plan which he believes will solve the problem which has been bothering the engineers for some time. His scheme contemplates two tracks on Liberty Street, with three tracks at the new station for stands for the Brooklyn City Railway; these stands are to be located so as not to interfere with vehicles from the bridge; the space from Sands Street curb to the rear of the stand will be about 80 feet, thus leaving a large open space for vehicles between curb and car tracks. Vehicles can follow the outgoing cars to the large open space at the junction of Liberty and Fulton Streets, and may then proceed on Clinton, Fulton or Tillary Streets. The Flushing Avenue cars will run down Washington Street to Front Street. The DeKalb Avenue line is to have two stands, about 60 feet from the Sands Street curb. The Jay Street line may curve around High Street into Washington Street, and the Atlantic Avenue line is to have two stands south of High Street at Washington Street. Mayor Schieren objects to the plan on the ground that the occupancy by railways of Liberty Street and the plaza is obnoxious. He contends that the original Howell plan can be made practicable if the companies wish to make it so.

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., Aug. 24, 1895.

PROVIDENCE, R. I.—The City Council has passed an ordinance granting permission to the Narragansett Electric Lighting Company for the erection of poles and wires through some 10 or 20 streets. The plant and service will be considerably extended.

SOMERVILLE, MASS.—The second line of horse cars which traverse Somerville will, in the near future, be supplanted by an electric car line. Work has been mapped out, and will be shortly consummated, for removing the Union Square line of horse cars, and the old line of Clarendon Hill horse cars, which run from Clarendon Hill to Park Square, Boston, will be equipped with electricity. When both of these lines are supplied with electric cars, no horse cars will be running into Somerville.

HAVERHILL, MASS.—The Massachusetts Street Railway Association, composed of managers, superintendents and directors of the electric roads of the State, on Wednesday last enjoyed an outing under the auspices of the Lowell, Lawrence & Haverhill road. The start was made from Lowell this morning in two special cars. The Haverhill party was met here. It included the directors of the proposed Haverhill, Georgetown & Danvers road. The steamer *Merrimac* took the party to The Pines. In the dance hall, which had been artistically decorated with bunting, a banquet was served. When dinner was finished a trip down the river on the steamer was enjoyed.

GLOUCESTER, MASS.—The Gloucester, Essex & Beverly Street Railway was formally opened last Monday, and the event was celebrated by the Business Men's Association. A large party, including officials of the road, members of the Business Men's Association, street railway officials, etc., took a trip over the road Monday morning, and the party was largely augmented at Beverly. On the return to this city a banquet was given at the Surfside Hotel. President Ferguson presided and introduced David S. Presson as toastmaster. Speeches were made by Mayor Cook, of this city; President of the Common Council Cole, of Beverly; Selectmen Kimball, of Essex; Knowlton, of Hamilton, and Perkins, of Wenham; Col. J. H. Cunningham, president of the Massachusetts Street Railway Company; W. Frank Parsons, and Mr. Fred W. Tibbetts, of this city.

TELEPHONE CIRCLES in Boston were not at all surprised over the suit for infringement of the Berliner patent which was entered recently by the American Bell Telephone Company against the National Telephone Manufacturing Company of Boston. The surprise really has been that suit was not brought earlier. From all the information that can be gathered at this writing the suit will be ably and bitterly contested by the National Company, in which, of course, the money and influence of the combination of independent telephone companies will figure, and new and important evidence, it is said, will be presented. The National Company declares it will continue the manufacture of its instruments and will not permit any interference in this direction during the contest of the suit. The Century Telephone Company and the Bay State Telephone Company state that they have simply received a notification from the American Bell Company not to place on the market any instruments that conflict with its patents. The Century Company claims that neither its patent, instruments or switchboard conflict in any way with the Bell patents.

Canadian Notes.

Ottawa, Ont., Aug. 23, 1895.

PETERBORO, ONT.—The Canadian General Electric Company is calling for tenders for the erection of a car shop 60 x 330 feet in connection with their works.

AYLMER, QUE.—The charter of the Aylmer Electric Railway expires shortly, but the promoters expect to secure an extension of time for the construction of their road.

OTTAWA, ONT.—The very large number of wrecks that have taken place in the Straits of Belle Isle has moved the Board of Underwriters to appeal to the government to extend telegraphic communication to that remote point.

HUNTINGTON, QUE.—The Town Council has authorized the mayor to sign a contract with the Stadacona Water, Power & Light Company, of Montreal, for supplying water works, sewerage and electric light to the town.

MONTREAL, QUE.—The Electric Belt Line is to be pushed forward as rapidly as possible. Messrs. Howard, Leamy & Murphy, who have the contract for the 12 miles of road from Hochelaga to Bout de L'Isle expect to have the work completed in three months.

LONDON, ONT.—The London Street Railway Company has called a meeting of shareholders for the purpose of providing the necessary means for electrifying the present system and extending the same, and to authorize the issue of debentures to the amount of $250,000. Work has commenced on the London Electric Railway power house.

MONTREAL, QUE.—The Lachine Rapids Hydraulic Company are going ahead with the construction of their dam by which it is proposed to supply Montreal with cheap electrical power. The contractors guarantee to supply Montreal by May 3, 1897. The dam will be over 4,000 feet in length and the head of water that will be secured it is expected will give the company at least 8,000 hp.

VANKLEEK HILL, ONT. — The work of overhauling and remodeling the electric light plant here is progressing rapidly under the supervision of P. E. Marchand, who is in charge of the construction department of Robert Anderson, of Ottawa, who makes a specialty of this class of work. Mr. Anderson has a considerable quantity of contract work in progress in Ottawa and reports an unusual press of business for this season of the year.

MONTREAL, QUE.—The Central Light & Power Company is making application for a charter for the purpose of constructing and operating works for the manufacture of electrical machinery. Also to enable the company to produce and distribute electricity for lighting, heating and power purposes at different points in Canada. The capital stock of the company is $50,000. The first directors are Richard White, J. C. Bowden and E. H. Barker, of Montreal.

OTTAWA, ONT.—The government has passed an order in council defining the regulations for the inspection of electric meters. It provides that all electric light supply meters shall be presented for verification, one third before Dec. 1, 1895, one third before March 1, 1896, and one third before July 1, 1896. The order further provides that for every unverified meter found in use after July 1, next, the owner, that is, the company, not the consumer, shall incur a penalty of $25. The fine for failure to neglect to afford the government inspector ample testing facilities render the contractor liable to a penalty of $5.

English Notes.

(From Our Own Correspondent.)

London, Aug. 20, 1895.

SCREWS.—An outcry has been raised against screws with the standard British Association pitches. It has been observed that not only do screws supplied by different makers differ considerably in pitch, but that the same maker's screws differ from month to month. The matter is occupying the attention of some practical men, and is likely to give rise to a discussion at the next meeting of the British Association.

THE CITY & SOUTH LONDON RAILWAY.—At a meeting of the shareholders of this company last week, the chairman stated that the extension of the line northward had been definitely decided, and, in consequence, further experiments with motor car trains would not be made, as following on the extension of the line they would be able to run heavier trains, and therefore it would require more powerful motors on the cars than at present necessary.

VESTRY MONOPOLY.—A loud outcry is being made at St. Pancras on account of the action, first, of the electrical committee of the vestry, and afterward of the entire vestry itself in refusing to sanction the laying down of hydraulic power mains in that district, the ground of the refusal being that to grant permission would be to sanction a competitive system of power distribution, as the vestry itself supplies electrical power for motor purposes as well as for electric lighting. Thus has a municipal body constituted itself a tyrannical monopolist.

MAGNETIC UNITS.—The near approach of the British Association meeting, which will be held this year at Ipswich early in September, is creating interest afresh in the subject of magnetic units. A kind of manifesto has been promulgated by Dr. Oliver Lodge, in which he advocates a certain system. This system, which is far from simple, seems likely to be crushed between the opposition of extreme theorists and that of thorough "practicians," as Mr. Oliver Heaviside calls them. The extreme theorists will not sanction any system which has not a radical cure for 4π and the "practicians" are not likely to adopt so complicated a system of units for practical work.

STREET BOXES.—An important decision has just been given by Mr. Justice Stirling in an action brought by the Wandsworth Board of Works against the County of London & Brush Provincial Electric Lighting Company. The plaintiffs objected to the transformer chambers, which the defendants were making beneath the streets in the Wandsworth parish, the ground of the objection being that such capacious chambers could hardly be called "street boxes." Mr. Justice Stirling decided that the size of an excavation had not necessarily anything to do with the fact of its being a street box, and he gave it as his opinion that the Board of Trade was quite competent to settle the maximum size which such chambers should have in any particular locality. As the Board of Trade had granted permission for these particular pits, judgment was in favor of the defendants.

HYDRAULIC POWER FOR ELECTRIC CENTRAL STATIONS.—In an interesting paper read before the Institution of Mechanical Engineers in Glasgow, Mr. E. B. Ellington, of the London Hydraulic Power Company, discussed the question of the economy of electric lighting central stations obtaining their power from the mains of his company. In making the comparison, 1,000 gallons of water at 750 pounds pressure per square inch was taken as an equivalent to 6.5 kw-hours. Mr. Ellington stated that on this basis the actual station cost of a kilowatt-hour was respectively 0.79d. and 1.38d. in the case of his own company and the Westminster Electric Supply Corporation. With a view of further increasing the value of the comparison, he further stated that the annual output and the capital employed by both companies averaged the same. No other conclusion could, he thought, be drawn from his figures than that for some reason or other, not hitherto explained, hydraulic power was much less costly to produce than electricity. It might be decided that the low annual load factor, 0.18, for the electric supply as against 0.33 for the hydraulic, accounted for most of the difference. The immediate question was, however, the economy of using hydraulic power for generating electricity, and it would

be seen that with a loss of 33 per cent. of the hydraulic energy during conversion into electric energy, the station cost of 0.79d. per unit, would rise to 1.19d. or about 0.2d. below the station cost of the Westminster Company on its present system. Notwithstanding this margin of 0.2d. per unit for profit and other contingencies, Mr. Ellington does not favor the idea of substituting hydraulic power taken from the mains of his company as a motive power for electric central stations in London.

General News.

NEW INCORPORATIONS.

THE PORTLAND & WESTERN RAILWAY COMPANY, Portland, Ore., has been incorporated with a capital stock of $25,000 to build electric roads. The incorporators are S. Z. Mitchell, W. F. Nelson and F. V. Holman.

THE FLAVEL TERMINAL & TOWNSITE COMPANY, Astoria, Ore., capital stock $50,000, has been formed to buy and sell lands, build railways, electric roads, steamboats, etc., by C. Wingate, Alfred Kinney and D. M. Stuart, Astoria, Ore.

THE KANE ELECTRIC COMPANY, Kane, Pa., capital stock $1,000, has been formed to supply light, heat and power by electricity to the public in the borough of Kane, McKean County, Pa., by C. H. Kemp, F. A. Lyte, Joshua Davis, Thomas L. Kane and W. P. Weston, Kane, Pa.

THE ELECTRIC LIGHT, POWER & TELEPHONE COMPANY, Eagle River, Wis., has been formed for the purpose of establishing an electric light, power and telephone system. The promoters are W. S. Carr, Byron Ripley and O. H. Campbell, Iron River, Wis. Capital stock, $20,000.

BUENA VISTA LIGHT & POWER COMPANY, Buena Vista, Va., capital stock $25,000, has been incorporated for the purpose of generating light, heat and power. The promoters are S. E. Egolf, R. B. Embree, H. N. Egoff, E. L. Embree, Buena Vista, and Thomas Bohman, Philadelphia, Pa.

THE FOX RIVER DEVELOPMENT COMPANY, Chicago, Ill., capital stock $100,000, has been incorporated for the purpose of constructing, operating and maintaining electric lighting plants, water works, etc. Among those interested are Preston W. Gray, John B. Ruhland and Thomas R. Cone.

THE AMERICAN ELECTRIC FUSE COMPANY, Chicago, Ill., capital stock $25,000, has been formed for the purpose of manufacturing and selling electric fuse and fusible cut-outs and other electrical appliances. The promoters are Eugene Hildebrand, Clarence E. Brown and Ralph W. Bowman.

THE MOUNTAIN ELECTRIC COMPANY, Summit, N. J., has been incorporated to establish, build, buy, sell and operate electrical plants for generating and supplying electricity for lighting, heating and power purposes. The promoters are Canol Ph. Bassett, Fred Green and Adolph Wagner, of Summit.

AMERICAN SIGNAL & POWER COMPANY, Minneapolis, Minn., capital stock $100,000, has been formed to manufacture electrical and other instruments, devices, apparatus, appliances, novelties, etc. Among those interested are Henry B. Higgins, Charles M. Wilkinson and Charles J. Traxler, of Minneapolis.

THE NEWARK (N. J.) ELECTRIC DEVELOPING COMPANY, capital stock $100,000, has been formed for the purpose of manufacturing electric appliances and machinery, and for selling the same. The promoters are Augustine Demarest, Eugene Eagles, Charles H. Madison, James H. Reinhardt, Newark, N. J.

THE INTERNATIONAL ELECTRIC COMPANY, of St. Louis, Mo., capital stock $15,000, has been incorporated for the purpose of manufacturing incandescent lamps. The promoters are J. M. Davey, St. Louis, Mo.; George DeLisle, St. Charles, Mo.; H. B. Russell, H. E. Chandler and H. G. Ferguson, St. Louis, Mo.

THE UNITED STATES ELECTRIC BELT COMPANY, Chicago, Ill., capital stock $10,000, has been formed to manufacture and deal in electric belts and other electrotherapeutical and surgical and body appliances, to own, control and deal in letters-patent for the same. The promoters are J. H. Lee, Lute S. Alter and M. J. Frost.

THE ARGENTINE WATER & LIGHT COMPANY, Portland, Me., capital stock $50,000, has been formed to manufacture and deal in gas, electricity and machinery, fixtures and apparatus for gas works, water works and electric light works. The promoters are W. C. Eaton, Geo. F. Noyes and Henry M. Merrill, all of Portland, Me.

THE RICHFIELD SPRINGS & SCHUYLER LAKE RAILWAY COMPANY, Richfield Springs, N. Y., has been formed for the purpose of building and operating an electric railway one mile long. Those interested in the project are C. B. L. Tylee, F. H. Vielle, C. M. Hyde, G. E. Tylee, all of Corning, N. Y.; capital stock $20,000.

THE DAYTON ELECTRIC FIRE ALARM COMPANY, Dayton, Ohio, capital stock $10,000, has been incorporated for the purpose of manufacturing all kinds of electrical apparatus, machinery and appliances. Those interested in the project are Elihu Thompson, Samuel G. Cain, Newton R. Bunker, Harvey Cortland and Albert Beebe.

THE SALT LAKE CITIZENS' ELECTRIC LIGHT COMPANY, Leadville, Col., capital stock $500,000, has been incorporated to construct and operate a system for furnishing light, heat and power in Lake County, Col., and Salt Lake County, Utah. The incorporators are Charles Boettcher, John F. Campion and George W. Trimble, Leadville, Col.

THE BENNINGTON GAS & ELECTRIC LIGHT COMPANY, Bennington, Vt., capital stock $75,000, has been formed for the purpose of manufacturing and distributing gas or electric light or both. Those interested in the project are Henry S. Jackson, Franklin S. Frisbie, William H. Kimball, George A. Senter, Benjamin V. Page, Boston, Mass.

THE NATIONAL ELECTRIC PLUMBING COMPANY, Cleveland, Ohio, capital stock $25,000, has been incorporated for the purpose of manufacturing and dealing in all kinds of plumbing and sanitary goods, light and electrica machinery. The promoters are William T. O'Mara, William H. Cleveland, William J. Gleason, George S. Papworth and M. J. Kelly.

TELEGRAPH AND TELEPHONE.

DES MOINES, IA.—The Anthony Telephone Company, of Cleveland, O., is seeking a franchise to operate in this city.

EVANSTON, ILL.—The citizens have petitioned the Council to order all telephone or electric wires to be conduited.

SCRANTON, PA.—A telephone system is to be installed here by Messrs. Tiffany, Rogers and others, in the near future.

LANSDOWNE, PA.—It is very probable that telephonic communication will be established betwen this town and Philadelphia.

SAN JOSE, CAL.—The California Telephone & Construction Company have been granted a franchise through San Jose for 35 years.

INDIANAPOLIS, IND.—The City Council passed an ordinance requiring all telegraph and telephone lines to be placed underground.

SIDNEY, N. Y.—A. H. Bartley has been granted a franchise by the village Board of Trustees, to establish a telephone exchange service.

SYRACUSE, N. Y.—The Central New York Telephone & Telegraph Company intends in a short time to construct a direct line between Syracuse and Oneida.

WILLIMANTIC, CONN.—The Southern New England Telephone Company has made application to the Common Council for permission to put its wires underground.

COLUMBIA, S. C.—An opposition telephone company is being organized to compete with the local Bell Company. W. Y. Abraham is to be president, and can furnish definite information.

WEST BOYLSTON, MASS.—The Long Distance Telephone Company is making arrangements for a new test station and house at this place, to be located near the Clarendon Mills.

SPARTA, WIS.—A telephone line is to be constructed from this place to Tomah, via Angelo, Lafayette and Tunnel City. J. B. Rice of this place, and H. M. Towle, of Tomah, are interested.

CAIRO, ILL.—The new telephone company, which was given a franchise by the City Council recently, will soon commence work. Thomas W. Cannon is one of the promoters of the enterprise.

WHEELING, W. VA.—Telephonic connection can now be had with Waynesburg, Graysville and Jacksonville and other points in Green County, Pa., via Cameron, through the central office at this place.

MILWAUKEE, WIS.—Fred. Kraus, of Milwaukee, who is interested in the National Telephone Company, will ask the City Council of Menasha for right of way to build a telephone exchange in that city.

WEST CHESTER, PA.—A charter has been applied for by the directors of the telephone company of Chester, Lancaster, and Delaware County. The line will be run first from Oxford to the Susquehanna River.

SPARTA, WIS.—The City Council has granted a franchise to J. P. Rice and H. M. Sowle for the construction and maintenance of telephone lines through the streets. It is understood that a toll line will be built to Tomah.

LYLE, MINN.—Hon. Walter H. Butler, ex-Congressman of Waterloo, Ia., has been in Lyle in the interest of the Western Electric Telephone Company. This company has a project to build a telephone line from Dubuque to Sioux City.

FARGO, N. D.—State Senator Rourke, of Ranson County, is here in conference with Manager Garret, of the Northwestern Telephone Exchange, with a view to building a line to Lisbon, connecting with the Fargo & Grand Forks Circuit.

JEFFERSON, GA.—A petition has been filed at the office of the clerk, Superior Court, Jackson County, for a charter for the Jefferson Telephone & Telegraph Company. It is the intention to build a telephone line from Jefferson to Athens.

NORRISTOWN, PA.—The Norristown & Philadelphia Telephone & Telegraph Company has asked permission of the Town Council to construct a telephone line in Norristown, using the underground system of wires. The company offers in return for the franchise to pave all streets in which its conduits are laid, to supply free phones for all borough offices and fire engine houses and pay to the borough annually 2½ per cent. of its net income. A franchise will probably be granted.

ELECTRIC LIGHT AND POWER.

BATTSVILLE, IND.—The City Council has voted to put in an electric light system.

WILKESBARRE, PA.—A new electric light plant will be built at Mill Creek north of Wilkesbarre.

MILTON, PA.—The Milton electric light plant is to be enlarged and the wires extended to Watsontown.

PERU, IND.—The electric light plant of the Wayne Hotel has been destroyed by fire. It will be replaced.

DAWSON, GA.—Bonds have been placed to the amount of $10,000, and that amount will be expended for electric lights.

FLUSHING, MICH.—Proposals for a system of water works and electric light plant will be received by W. H. J. Martin for the village.

MALACA, MINN.—The village has voted to issue bonds for the purpose of putting in an electric light plant and a system of water works.

BATAVIA, N. Y.—Alderman Ditzell can probably give information regarding the putting in of an incandescent dynamo in the city lighting plant.

PHŒNIX, ARIZ.—The Phœnix Electric Light & Fuel Company has purchased J. J. Gardiner's electric light plant. The price paid is understood to have been $10,000.

LANCASTER, O.—The City Council is considering the question of granting a franchise to the new telephone company in which H. W. Winkoop and A. L. Conger are interested.

PEORIA, ILL.—Congressman J. Frank Aldrich, backed by a syndicate, proposes to construct a new gas and electric light plant at a cost of several hundred thousand dollars.

MOLINE, ILL.—The People's Power Company will erect a building just east of the present power house, which will be supplied with new machinery and used as an additional power house.

RUSHVILLE, ILL.—The electric light company has had the misfortune of having its arc-light dynamo damaged. The city has not yet decided whether to renew the contract which expires in December.

WEST SCRANTON, PA.—The West Side Board of Trade held a meeting recently, with President T. F. Mason in the chair, to take steps toward establishing an electric light plant on that side of the city.

MILWAUKEE, WIS.—The electric light question at Whitewater is settled for the present. The Electric Light Company has accepted the Council's terms, and is to furnish the lights for five years, at $90 a year for each light.

CLEVELAND, O.—Sealed proposals will be received by E. A. Abbott, director of police, until Aug. 31, for the furnishing and installation of 20 police signal boxes, with all the necessary central office equipment and accessories.

LEBANON, MO.—By a decree of the Laclede County Circuit Court all property of the Lebanon Light & Water Company, including the Gasconade Hotel, electric light and water plant, real estate, etc., is to be sold in this city Oct. 19, 1895. Under the decree of foreclosure the properties may be sold separately or for one sum for cash.

APPLETON, WIS.—The contract for lighting the city of Menasha has been awarded to the Citizens' Electric Company of this city. The contract calls for about 65 lights of 1,200 cp each, the price per light being $80 a year. The work of erecting a line from here to Menasha will begin at once, and the plant will be in running order very soon.

TAMAQUA, PA.—The question of light is being considered by the Tamaqua borough Council, and at its last meeting propositions were received from the Ball Electric Light Company, of New York, to furnish 80 arc lights at $60 per annum each, and from the Edison Company, of Tamaqua, to furnish 60 arc lights and 40 incandescent lights for $5,000 per annum. No definite action has yet been taken.

PATERSON, N. J.—The control of the Rutherford, Boiling Springs & Carlstadt Electric Light Company has passed into new hands. Samuel P. Ferree and Barr Ferree, of Brooklyn, are the new owners, the latter being president and the former treasurer. The other officers are: Vice-president, Andrew Wilson; secretary, Albert Buys. These four, with George H. Southard, president of the Franklin Trust Company, of Brooklyn, constitute the new board of directors.

SUMMIT, N. J.—The township committee has accepted C. P. Bassett's proposition for lighting the streets. The contract specifies 10 arc lamps of 1,000 cp each, at $112.50 a year per light, and 200 25-cp lights, at $16.95 a light. This is cheaper than any preceding offer. The price for private consumption will be one cent a light an hour, nine tenths of a cent a light an hour for commercial lights, and lower rates where a large number of lights are required. The Mountain Water Company is backing the enterprise.

THE ELECTRIC RAILWAY.

UNION, N. Y.—Work of grading the electric road between Union and Binghamton has been commenced.

CHARLESTON, S. C.—The construction of an electric road between Charleston and Somerville is talked of.

ALBANY, N. Y.—A franchise has been granted to the Albany, Greenbush & Bath Railway by the Greenbush trustees.

FT. WAYNE, IND.—A franchise has been granted for an electric road from Ft. Wayne to Lake Everett, 11 miles distant.

CAMBRIDGE, PA.—The Borough Council has granted another franchise to the Cambridge & Edinboro Railway Company.

TROY, N. Y.—Troy City Railway Company will probably extend the road up Oakwood Avenue to Oakwood and St. Peter's cemetery.

PITTSBURG, PA.—The power house of the West End Electric Railway at the south end of Point Bridge was wrecked by a storm recently.

MIDDLETOWN, N. Y.—The Traction Company is seeking a franchise through Bonnell and Stanton Streets to extend the electric road.

ALLEGHENY, PA.—The Pleasant Valley Traction Company has asked the Allegheny Council for franchises to occupy the streets of the city.

CAIRO, N. Y.—The Cairo & Windham Turnpike has been purchased by a number of capitalists, who propose to build an electric railway from Cairo to Prattsville.

PASSAIC, N. J.—The Passaic & Newark Traction Company has executed a mortgage for $210,000 to the Passaic Trust Company to raise funds for the completion of its line.

NEWBURGH, N. Y.—The Homer Ramsdell Transportation Company, of Greenburgh, is behind a syndicate who will build an electric railway from Newburgh to New Paltz.

PHILADELPHIA, PA.—Electricity will in all probability be substituted for steam on the Millstone branch of the Pennsylvania Railway, in the hope of making the road a paying one.

TROY, N. Y.—Martin Schenck, of Troy, and T. W. Cantwell, of Albany, are directors of a company which proposes to construct an electric railway between Schuylerville and Greenwich.

SCRANTON, PA.—A charter has been granted to Dunmore Electric Street Railway Company to build a street railway between Dunmore and Scranton. P. J. Horan, of Dunmore, is president.

RICHMOND, VA.—The Richmond Traction Company, composed of Everett Weddey, Reuben Sheriffs, Philip B. Shield, Charles T. Child and others, will build an electric trolley line on Broad Street.

WATKINS, N. Y.—It is now announced that the Watkins & Havana Railway is to be constructed to Horseheads and the Elmira line of electric cars. A number of New York capitalists are interested.

AUBURN, N. Y.—The Auburn City Railway Company has filed at Albany a notice of its intention to extend its lines through the second ward to the lake, and also through the towns of Throop, Nentz and Brutus.

SYRACUSE, N. Y.—Mayor Amos has filed with the city clerk two vetoes of resolutions of the Common Council, one of which was the resolution granting a franchise to the Syracuse & South Bay Railway Company.

BALTIMORE, MD.—Plans have been completed for a new brick power house for the Baltimore, Middle River & Sparrows Point Railway at Fairy Grove. The station will be equipped with the most modern machinery.

FORT WAYNE, IND.—Fort Wayne, Maysville, Hicksville, Farmer Centre, William Centre and Bryan will be connected by an electric railway. Cost of equipping and constructing the line is estimated at from $500,000 to $700,000.

PORTLAND, ME.—Portland & Yarmouth Electric Railway Company has asked for the location of its street railway within the city of Portland. Thomas G. Harris, clerk in board of mayor and aldermen. Edwin L. Dyer, city clerk.

NEWARK, N. J.—A franchise has been applied for by the Suburban Traction Company to build an electric line through Union and Nassau Streets and Valley Road. The secretary of the company can be addressed for detailed information.

CORUNNA, MICH.—The Owasso & Corunna Street Railway, with all its appurtenances, has been sold to Alexander Ralph, of Philadelphia, for $5,000. The railway, which has been in operation for nearly three years, was capitalized at $40,000.

MINNEAPOLIS, MINN.—Minneapolis is considering the question of putting both railway and telephone wires underground and has sent a committee of alderman to Chicago to investigate the merits or demerits of various wires. J. McMichard is chairman.

BOSTON, MASS.—A scheme to build an electric railway between Boston and Cottage City, with a connecting ferry, is receiving serious attention. So far as planned, the road will follow the line of the Old Colony division of the N. Y., N. H. & H. road to Falmouth.

MEADVILLE, PA.—There is a movement in progress for the construction of an electric railway from Meadville to Edinboro via Saegertown and Cambridge, and the route has been surveyed. Cost of constructing the entire road has been estimated at $400,000.

NEWARK, N. J.—Injunction has been granted by Vice Chancellor Pitney restraining the New Brunswick Trolley Company from building an electric road between New Brunswick and South Amboy. The petitioners are Mrs. Anna M. Clark, a large property owner, and others.

TIFFIN, O.—The Tiffin & Fostoria Electric Street Railway line, upon which about $30,000 has already been expended, was last week offered by the sheriff for sale the second time without receiving a bid. The property was appraised at $24,000 and will now be advertised and reappraised.

MONTCLAIR, N. J.—The Suburban Traction Company, of Orange, will apply to the Town Council for a franchise to operate a route to Montclair, from Harrison Avenue, at the West Orange terminus, to upper Montclair, from there to Bloomfield and one to the Bloomfield Railway line.

LOS ANGELES, CAL.—The injunction against the sale of the Los Angeles consolidated electric road has been dissolved and the property was bought by the syndicate representing the majority bondholders. The bid was $1,500,000. Another bid was made on behalf of W. H. Workman and Chicago capitalists of $1,000,000.

KNOXVILLE, TENN.—The Citizens' Railway Company has filed application for charter. The company proposes to build and operate an electric line in Knoxville, West Knoxville, North Knoxville and Knox County. It may possibly be consolidated with the West End electric road and the Fountain City dummy line.

CANTON, OHIO.—The proposed street railway from Canton to Akron, and thence to Cleveland, by way of the Akron, Bedford & Cleveland road, has now assumed such definite shape that there seems to be no doubt as to its success. The enterprise is backed by W. A. Lynch, of Canton, president of the Canton & Massillon Interurban line.

ALBANY, N. Y.—At 71 State Street some 40 representative men from Albany, Clarksville, New Salem, Berne, Gallupville and Schoharie, met and organized the Albany, Henderberg & Schoharie Railway. The directors are B. M. Secor, C. W. Van Valkenburg, L. C. Warner, Jonas M. Brooks, all of Albany, Ezra Twitchell, of Schoharie, and others.

POTTSVILLE, PA.—Sealed proposals will be received at the railway company's office, South Centre Street, Pottsville, for the building of six miles of electric railway from Schuylkill Haven to Pottsville, and six miles from Minersville to Heckscherville and Taylorsville. Plans and specifications at the office of the company. Address W. W. Hess, president of the Philadelphia Construction Company.

POTTSVILLE, PA.—The Williams Valley Street Railway Company, which several weeks ago received a charter to operate a trolley road in the western end of Schuylkill County, between Tower City and Lykens, will commence the construction of the road within a few days. The right of way has been secured over the whole of the proposed route. The company has a capital stock of $100,000. Charles H. Barmhardt, of Girardville, is the secretary and treasurer of the corporation.

ST. LOUIS, MO.—The Citizens' Railway Company is getting a consignment of 60-foot steel rails with which to reconstruct its track on Franklin and Easton Avenues and Morgan Street. The rails are now being distributed

along the line with a long coupled wagon with a tiller arrangement for guiding the rear truck. The work of reconstructing the tracks will begin at once. This is the first road in the country to use the 60-foot rail for street car tracks. They will be welded by electricity, making the tracks continuous.

CLYDE, N. Y.—There is strong talk of building an electric road from this village to Bonnicastle, the summer resort at Sodus Bay, a distance of twelve miles. The Niagara Electric Company, of Niagara Falls, has made an offer to the towns of Galen, Rose and Huron to build the road if the towns will pledge the sum of $10,000. The company guarantees 10 per cent. dividends within three years' time. The proposed road would connect with the Central Hudson Railway at Clyde and with the Rome, Watertown & Ogdensburg Railway at North Rose.

Trade and Industrial Notes.

AMONG THE YACHTS on which Chloride accumulators have been installed for lighting purposes this season are the *Linta*, *Sultana*, *Alcedo*, *Duquesne*, *Huntress*, *Washita*, *Vidette* and *Thespia*.

A UNIQUE WIRING TABLE is being issued by the Electric Appliance Company of Chicago. This table is of such a shape and size as to fit inside of a watch case, and is known as Wells' Watch Case wiring table.

J. H. VAIL, of 39 Cortlandt Street, New York, has been appointed consulting engineer by the State Mutual Life Assurance Company, of Worcester, Mass., and is engaged in preparing plans for a complete electric lighting plant of the best type.

THE CONSOLIDATED CAR FENDER COMPANY, of Providence, R. I., has just received an order from the Union Depot Street Railway Company, of St. Louis, to equip its entire system, and Col. A. C. Woodworth, manager, reports business generally as good. The Consolidated fender possesses a good record for effective work.

A 400-WIRE SWITCHBOARD is being made for a telephone exchange in Pennsylvania by the Eastern Electric Company, of Tonawanda, N. Y., to be finished by Oct. 1. This board was ordered by the purchasers after a thorough examination as to reliability, efficiency, patented features, etc., of all the boards on the market, which speaks well for the class of work turned out by the Eastern Electric Company.

A SUBSTANTIAL ORDER has been received by the Beacon Lamp Company, Irvington Street, Boston, from the Boston Electric Light Company. The order is for 9,000 incandescent lamps to be used in decorative work for the Knight Templars this week. An order was also received from Keith's Theatre for 1,000 lamps for similar service, and the Beacon Company has been awarded the government contract for 10,000 lamps for the navy yard.

NEW SUPPLY AND CONTRACTING FIRM.—John B. Hoefgen and Edgar C. Moxham have recently established a supply and contracting house in New York, with offices in the Wolfe Building, 80 William Street. They will be in position to supply all kinds of street railway equipment. Mr. Hoefgen was until recently the general manager of the Nassau Electric Railway Company, of Brooklyn. The firm will be known as Hoefgen, Moxham & Co.

THE ARGENTINE REPUBLIC shows a decided intention to keep pace with the scientific world in the matter of industrial applications. The government buildings at Buenos Ayres are to be lighted by a private plant, which will include a chloride accumulator installation of 216 kw-hours' capacity, the contract for which has just been closed by the Electric Storage Battery Company, of Philadelphia. This company has also closed a contract with the German Liederkranz Society, of New York, for a lighting battery with a capacity of 132 kw-hours, and the Western Union Telegraph Company is installing at Washington, D. C., under the supervision of its assistant electrical engineer, Mr. G. W. Gardanier, 796 chloride accumulator elements of various sizes.

ELECTRICITY AND POWDER, at first thought, would appear not to harmonize particularly well; upon further consideration, however, it is obvious that nothing could be safer for service in a powder mill than an electrical plant intelligently installed. The American Powder Company, of South Acton, Mass., appreciate the force of this fact, and have contracted with the General Electric Company for a three-phase plant comprising two 75-kw, 550-volt generators; three 5-hp, one 10-hp and eight 20-hp induction motors, for use in its mills. The General Electric Company has also closed a contract with the Boston Duck Company, of Bondsville, Mass., for a three-phase, 400-kw, 900-volt generator, and a synchronous motor of similar size, to transmit power from a water privilege to the mill, a distance of 3,000 feet.

H. J. MEDBERY, president of the Fiberite Company, manufacturers of the well-known Medbery material, recently said: "We find a steadily growing demand for improved grade and quality of supplies. We manufacture only high grades and feel encouraged at the change. Goods of inferior quality are not as much sought after, and, as a consequence, our factory is running twenty-four hours a day. People are building generally for permanency, and want the best material obtainable." The long and practical experience of Mr. Medbery, and the known quality of his goods, have won for the Medbery material an excellent reputation. The company has lately made some large shipments to foreign countries, and this business will be vigorously pushed. Offices have been established in New York, Chicago, Philadelphia, San Francisco and other large cities, in charge of well-known agents of established ability.

THE C. W. HUNT COMPANY, of 45 Broadway, New York, has just issued a new catalogue devoted to a description of its coal-handling apparatus for steam plants. The little volume is one which will be found of great interest to all those concerned in the operation of steam generating plants. It is thoroughly illustrated with admirable half-tone engravings showing some of the important plants in which the Hunt coal-handling apparatus has been introduced One of the interesting prefatory statements made in the catalogue is the following: "Taking coal from the hold of a vessel which comes at irregular times, storing it in a 6,000-ton pocket 800 feet distant, taking it from the pocket and delivering it continuously, day and night, to the front of the boilers, for a total cost, including the interest on the investment, of less than 3½ cents per ton, from the hold of the vessel to the boiler furnaces, manifestly requires a large expenditure for machinery. But the reduction of the cost of handling 25,000 tons of coal per annum from 27½ cents to 3½ cents per ton pays a net profit, above interest and all expenses, and available for dividends, of $6,000 per annum."

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th Street, New York. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 20, 1895.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

544,647. AUTOMATIC ELECTRICAL RAILWAY SIGNAL; C. R. Alsop, Middletown, Conn. App. filed Oct. 22, 1894. The combination of an electric motor, a swinging signal target attached to the armature shaft of the motor, track circuit closers, and a switch for automatically closing the circuit through the motor when the target reaches an elevated position.

544,673. SECONDARY BATTERY; F. King, London, Eng. App. filed April 5, 1895. The combination plates or electrodes having portions protruding in the form of a bar, a grid and a porous diaphragm, and envelope so as to fix the distance apart of the plates or electrodes, and maintain them in position and keep the active material in position thereon.

544,677. TROLLEY ARM AND ATTACHMENT; G. Maag, Newark, N. J. App. filed Dec. 12, 1894. A trolley arm composed of sections with a flexible joint connecting same and a flexible rod within, and means for securing the rod in position.

544,685. ELECTRIC LOCOMOTIVE; Edwin H. Porter, Radford, Va. App. filed June 22, 1894. In an electric locomotive the combination, with the driving axles of the locomotive, of cranks of a given radius carried thereby, main connecting rods joining those cranks which are on different axles, a pair of armatures of an electric motor, having cranks of half the length of the former, and connecting rods joining the armature cranks to the main connecting rods and having the same radius as the cranks of the driving wheels of the locomotive.

544,696. DYNAMOMETRIC GOVERNOR; W. N. Smith, Chicago, Ill. App. filed Aug. 16, 1894. The combination of a prime motor operating a dynamo and supplying an electric circuit, an air-compressing mechanism connected with and operated by the said prime motor and an electrical dynamometer lying in said circuit and controlling the operation of the air-compressing mechanism, so that the amount of air will vary with the amount of current passing through the dynamometer.

544,711. TELEPHONE SWITCH AND SYSTEM; E. C. Wilcox, Meriden, Conn. App. filed May 13, 1895. A combined receiver support and a switch consisting of a hook mounted on the wall of the telephone case, another hook co-operating therewith and pivoted to a bracket on the case, a switch contact carried by the movable hook, and a spring acting to hold the movable hook and its contact in either of their extreme positions.

544,745. ELECTRICALLY CONTROLLED WEIGHING APPARATUS; L. H. Nutting, Davenport, Ia. App. filed Nov. 13, 1894. In a weighing apparatus, the combination with a hopper having outlet doors therein and a feed chute for said hopper having an outlet gate therein, of electrically-controlled mechanism for alternately opening and closing the doors of the hopper and the gate of chute.

544,747. MANHOLE FOR ELECTRIC CABLE OR OTHER SUBWAYS; E. L. Ransome, Chicago, Ill. App. filed Jan. 11, 1895. A shell serving as a conduit for water or sewerage and having a series of smaller conduits in the body thereof, and a manhole chamber serving as a means of entering said main conduit, electric wires passing through the auxiliary conduits and around the wall of the said manhole chamber, and a shield for protecting all wires within said chamber.

544,749. ELECTRIC MOTOR; B. P. Remy, Peru, Ind. App. filed Nov. 24, 1894. The combination of radial electromagnets adapted to rotate together, a commutator suitably connected to said electromagnets, and a stationary iron part of an elliptical, oval, or similar shape, it generating no magnetism but obtaining its magnetism wholly by induction from the revolving part.

544,768. ELECTRIC ELEVATOR; N. O. Lindstrom, Union Course, N. Y. App. filed May 16, 1895. An electric elevator consisting of a car, a driving electrical motor, a magnetically operated circuit controller for reversing the motor, a switch on the car for operating the controller, and means for magnetically locking the controller against a sudden reversing movement.

544,774. AUTOMATIC SAFETY TROLLEY; J. B. Scranton, New Haven, Conn. App. filed March 30, 1895. A trolley finder consisting of a forked arm having blocks therein capable of a limited vertical movement and springs tending to force the blocks upward, an axle which bears in the said

blocks and divergent fingers connected thereto, the free ends of the fingers being forced upward or downward as the blocks are raised or lowered.

544,778. INSULATOR FOR ELECTRIC OR OTHER WIRES; C. Sproat and E. N. Tarr, Taunton, Mass. App. filed Jan. 2, 1895. An insulator consisting of a base and a cup or head provided with a series of concentric corrugations, and means for screwing down the head upon the base and holding fast a wire between them.

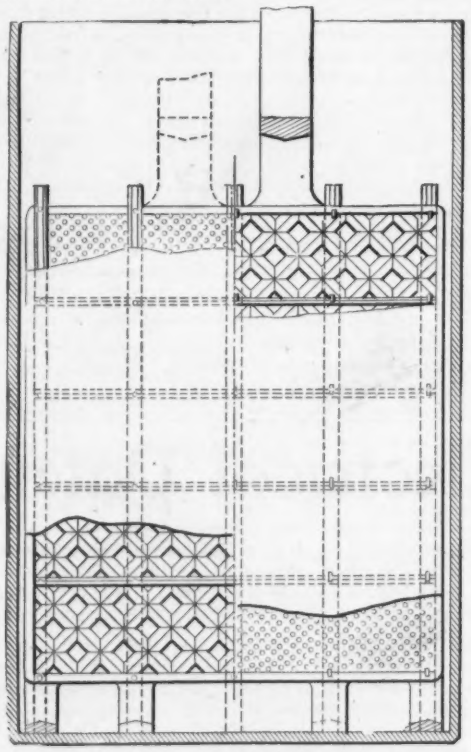
544,781. ELECTRIC SWITCH; T. H. Brady, New Britain, Conn. App. filed May 3, 1895. An electric switch having a contact jaw frame provided with devices for attaching a wire and securing the frame in place, a pair of rigid contact jaws pivoted to the frame on a common pintle, and a separate spring with its ends pressing in opposite directions upon the two members of the pair of jaws to move them separately on their frame.

544,794. TROLLEY ARM AND WIRE FINDER; F. W. Riess, Philadelphia, Pa. App. filed June 10, 1895. A trolley consisting of two parts pivoted together, the upper and very short part provided with a sliding fork containing the wheel and wire finders, and a spring adapted to keep the guard in about axial line.

544,802. RAILWAY SIGNAL; W. B. Vansize, New York, N. Y. App. filed July 17, 1895. The combination of a signal and rail circuits, a main battery for both circuits, a signal controlling magnet at one end of a section and a circuit-breaker at the other end, and a relay magnet controlling the circuit-breaker included in the rail circuit and insulated sections connected upon opposite sides of the battery.

544,844. CARBON BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES; A. J. Churchward, Brooklyn, N. Y. App. filed May 14, 1894. A holder consisting of a frame to hold brushes, angular plates secured to the brushes by screws, conducting rods secured to the plates and detachable therefrom, springs surrounding the rods, and a conductor connecting the conductor rod.

544,861. APPLYING POWER AT A DISTANCE BY MEANS OF ELECTRICITY; F. McLaughlin, Philadelphia, Pa. App. filed Oct. 8, 1891. The combination of a mechanical power-controlling device and an electric motor for actuating the same, with a coupling between them both automatically connecting and disconnecting them, and timed to engage the latter after the former has started without a load.



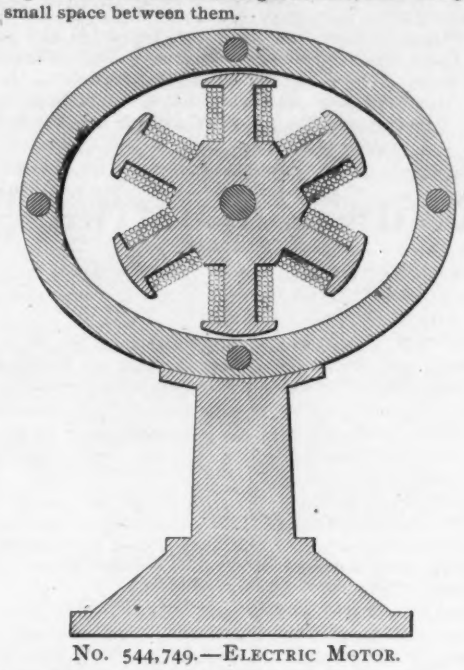
No. 544,673.—Secondary Battery.

544,862. App. filed April 17, 1895; 544,863. App. filed May 3, 1895. ELECTRIC RAILWAY. J. F. McLaughlin, Philadelphia, Pa. The combination of a main and supply conductors with switches for coupling the main and feeding conductors, each switch being provided with a rocking switch-lever, extending transversely to the line of travel, and having an armature on each side of its pivot and two traveling electromagnets, one acting on one armature and the other on the other armature of the switch levers.

544,867. OPERATING THROTTLE OF ENGINES; C. B. Silverwood and James Fraser, Philadelphia, Pa. App. filed May 21, 1895. The combination of a throttle valve, a sprocket wheel mounted on the stem thereof, another internally-threaded sprocket wheel mounted upon a threaded cylinder adjacent to the former, a rotatable shaft bearing on the cylinder having a disc thereon and pins engaging the sprocket wheel, and a clutch mechanism electrically controlling devices for throwing the clutch mechanism into operation, and means for throwing it out of operation when the valve is actuated.

544,876. SHIP'S TELEGRAPHIC APPARATUS; J. K. Adelsberg, Liverpool, Eng. App. filed March 16, 1895. An apparatus consisting of indicators, electromagnets pivotally mounted and vibrating armatures and toothed racks mounted thereon, pinions meshing with the said racks, shafts connecting with the pinions carrying pointers on one end adapted to move over the indicators to indicate what movements are to be made.

544,890. MAGNET-ELECTRIC TELEPHONE; M. Frank, Munich, Germany. App. filed June 30, 1894. A telephone having the magnetic core and surrounding magnetic shell magnetically connected, one diaphragm being connected to the shell, and the diaphragm armature of core connected with the opposing surfaces of the said magnetic core, both being parallel and having a small space between them.



No. 544,749.—Electric Motor.

544,894. FIRE EXTINGUISHER; W. Harkness, New York, N. Y. App. filed Aug. 13, 1888. The combination of a liquid supply pipe with branch pipes leading to different parts of a building, automatic sprinklers being attached to the said pipes, a tank for containing a non-freezing liquid, a source of water supply, the tank and water supply being connected with the supply pipe by independent connections, a movable valve located in one of the branch pipes and arranged to obstruct the flow of liquid therethrough, an electric circuit closer actuated by the valve, an alarm bell in a different room, and an electric circuit including the alarm and circuit closer.

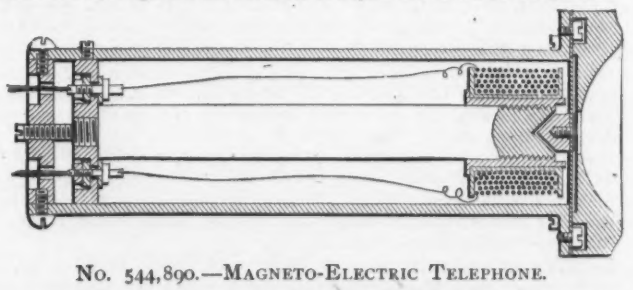
544,901. TELEPHONE EXCHANGE APPARATUS; J. J. O'Connell, Chicago, Ill. App. filed April 29, 1893. A system comprising a multiple switchboard and suitable adjunctive apparatus, an operator's telephone circuit and a key whereby the circuit is thrown into and out of circuit with the subscriber's line, a signal and controller connected with the key, whereby when the key is shifted to throw the operator's telephone into the subscriber's circuit, the signal will be brought into action to indicate that the operator is busy, and when the operator is through the signal will indicate the fact.

544,937. ELECTRIC TRAIN SIGNAL; F. C. E. Von Sternberg, Brooklyn, N. Y. App. filed April 13, 1895. A system consisting of a starting circuit including a generator and a signal and comprising two partial circuits located on each side of the train, each one being provided with a circuit-closing device arranged to hold it normally open, and arranged to form a shunt or short circuit when closed, to the other partial circuit on the same car.

544,959. INSULATOR; R. G. Collins and F. W. Foley, Dollar Bay, Mich. App. filed Feb. 25, 1895. The combination of a shield and a sheath, and means for clamping a wire between them.

545,005. MULTIPLE ELECTRIC CIRCUIT AND MECHANISM FOR MAINTAINING SAME; T. K. Ames and E. A. Parker, Peterborough, N. H. App. filed Oct. 19, 1894. A switch, means for rotating one part thereof, a series of distributing terminals, and a direct line wire serving to return the current from the working circuits to the generator.

545,009. TROLLEY; G. W. Biddell, Chattanooga, Tenn. App. filed Feb. 2 1895. A trolley having a sleeve or head on the end of a rod, a block pivoted upon the top thereof having a shoulder and carrying the wheel, and screws extending inwardly through said block to project inwardly beyond the same and abut against the shoulder to adjust the throw of the wheel.



No. 544,890.—Magneto-Electric Telephone.

545,020. ELECTRICALLY-CONTROLLED WINDING MECHANISM FOR TIME LOCKS; filed April 1, 1895. 545,021. Filed April 17, 1895. W. H. Hollar, G. L. Weaver and A. Kennedy, Philadelphia, Pa. The combination of a vault or safe, a rewinding electric motor within the vault and operatively related to the clock spring of the time lock, and means independent of the clock movement and located exterior to the vault, whereby the said circuit may be controlled.